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Lake Bonnet Drainage Basin Hazard Mitigation Project

Feasibility Study Report
Community Development Block Grant - Mitigation (CDBG-MIT) Program

City of Lakeland

Project Grant Number: MT047

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Quality information

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Acronyms and Abbreviations

AACE	American Association of Cost Estimating
Amec	Amec Foster Wheeler Environment & Infrastructure, Inc.
Arc	Arc Surveying & Mapping, Inc.
BAR	Biological Assessment Report
BMPs	Best Management Practices
BODR	Basis of Design Report
CDBG-MIT	Community Development Block Grant Mitigation
CFR	Code of Federal Regulations
COA	Class of Action
COC	Contaminant of Concern
CWA	Clean Water Act
CY	Cubic Yards
DOC	Department of Commerce
DTM	Digital Terrain Model
EOPC	Engineer’s Opinion of Probable Cost
ERP	Environmental Resource Permit
ESA	Endangered Species Act
F.A.C.	Florida Administrative Code
FAA	Federal Aviation Administration
FDEP	Florida Department of Environmental Protection
FDHR	Florida Division of Historical Resources
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
ft	Foot/Feet
FWC	Florida Fish and Wildlife Conservation Commission
FWS	Fish and Wildlife Service
HUD	U.S. Department of Housing and Urban Development
IDGM	Integrated Digital Geological Model
LiDAR	Light Detection and Ranging
LOMR	Letter of Map Revision
LOS	Level of Service
MGD	Million Gallons per Day
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Services
ROW	Right-of-Way
SHPO	State Historic Preservation Office
SMF	Sediment Management Facility
SPT	Standard Penetration Test
SWFWMD	Southwest Florida Water Management District
U.S.	United States
UMAM	Uniform Mitigation Assessment Method
USACE	U.S. Army Corps of Engineers
WBID	Water Body Identification

Executive Summary

The City of Lakeland (City) was awarded a $42.9 million grant from the Department of Commerce (DOC). The grant is facilitated through the U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant Mitigation (CDBG-MIT) initiative as part of the Rebuild Florida Mitigation General Infrastructure Program. Grants were awarded to complete large-scale infrastructure projects to mitigate and harden against natural disaster risks, including severe flooding and hurricanes, targeting HUD and State-designated impacted and distressed areas.

The Lake Bonnet Drainage Basin Flood Hazard Mitigation Project Feasibility Study Report (Report) has been prepared to comply with the grant's requirements. The Report presents the feasibility study conducted to identify a practical approach to mitigate flooding from the Lake Bonnet Drain at the May Manor Mobile Home Park and its adjacent areas. The Project Area/ Reach where improvements would occur along the Lake Bonnet Drain is approximately 3,210 feet between North Brunnell Parkway to North Wabash Avenue.

The Lake Bonnet Drain is a highly urbanized stream historically part of a natural channel that served as the outlet for Lake Bonnet. The Lake Bonnet Drain is 2.69 miles long, extending from North Brunnell Parkway to North Galloway Road with a contributing drainage area of 3.69 square miles that drains west to Itchepackesassa Creek.

The Lake Bonnet Drainage Basin Flood Hazard Mitigation Project consists of several elements, including wetland restoration, lake bottom sediment dredging, and the development of flood mitigation infrastructure to reduce flood risk for the May Manor Mobile Home Park and surrounding areas. Four flood mitigation alternatives were developed and evaluated as part of the feasibility study.

- Alternative 1: Channel Improvement (Berms and Floodwalls)
- Alternative 2: Channel Improvement (Floodwalls)
- Alternative 3: Backpumping to Lake Bonnet
- Alternative 4: Detention (Pond/ Underground Storage)

The flood mitigation alternatives were compared based on several assessment components, including the level of service (LOS) performance, offsite impacts (flood levels and flows), engineer's opinion of probable cost (EOPC), permit issues, mitigation requirements, and feasibility, FEMA compliance, property/ right-of-way (ROW) requirements, and constructability. The assessment components were intended to provide an equal and quantifiable comparison of the alternatives to allow the City to make an informed decision on selecting a preferred alternative.

Based on the study results, the City of Lakeland selected Alternative 3 as the preferred flood mitigation strategy. Alternative 3 involves the installation of a pump station just downstream of the Lake Bonnet outlet control structure to backpump stormwater from the Lake Bonnet Drain into the lake. This approach includes dredging a 3,210-foot segment of the Lake Bonnet Drain channel with a negative slope to collect stormwater, which will then be pumped across North Brunnell Parkway via a force main. Channel improvements within the Lake Bonnet Drain involve regrading, floodwalls, and additional sump pump stations to handle local drainage in low-lying areas. The approach also includes lowering the current water level elevation at the lake to increase the hydraulic storage volume. The analysis of Alternative 3 indicates the following number of structures will be removed from the risk of flooding within the Project Reach for the various storm events:

- 2.33-year storm: 42 of 43 structures removed
- 10-year storm: 102 of 108 structures removed
- 25-year storm: 113 of 154 structures removed
- 100-year storm: 88 of 220 structures removed

Results also indicate that there is no increase in water surface elevations in Lake Bonnet Drain downstream of North Wabash Avenue compared to existing conditions. The backpumping to Lake Bonnet alternative will also reduce flooding duration within the study reach. It is important to note that Lake Bonnet may not have enough storage capacity to mitigate flooding during consecutive storm events if there is insufficient opportunity to discharge water from the first storm, reducing the storage capacity of Lake Bonnet for the next storm.

The long-term operation and maintenance will include routine maintenance, such as removing debris and sediment within Lake Bonnet Drain and maintaining the pump facilities, such as exercising the generators and pumps and maintaining the access path leading to the sump pumps. A location to store spare parts for the pump equipment needs to be identified. The City of Lakeland will need in-house staff or an outside consultant with technical expertise to diagnose, repair, operate, and maintain the pumps.

The improvements for Alternative 3 will occur on Sterling Homes, May Manor, and other private properties adjacent to Lake Bonnet and within the North Brunnell Parkway right-of-way. Therefore, concurrence will be required from the affected properties to execute the flood mitigation project successfully.

1. Introduction

The City of Lakeland (City) received a $42.9 million grant from the Florida Department of Commerce (DOC) to complete the Lake Bonnet Drainage Basin Flood Hazard Mitigation Project. The grant is facilitated through the U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grant Mitigation (CDBG-MIT) initiative based on an application that was approved within the Rebuild Florida Mitigation General Infrastructure Program. The project consists of several elements, including wetland restoration, lake bottom sediment dredging, and the development of flood mitigation infrastructure to reduce flood risk for the May Manor Mobile Home Park and surrounding areas. The project will be carried out in three phases: Phase 1 – Feasibility Study; Phase 2 – Design, Permitting, Communication, and Coordination with property owners for potential property acquisition and/or easements and the public at large, as well as the development of a project implementation plan; and Phase 3 – Construction. Each phase is designed to ensure comprehensive planning and execution, emphasizing stakeholder engagement and effective flood risk mitigation.

This report documents the Phase 1 Feasibility Study for the Lake Bonnet Drainage Basin Flood Hazard Mitigation Project. The feasibility study includes a range of analyses, such as hydrologic modeling and cost estimates, as well as assessments of potential impacts, compliance, and constructability of four conceptual-level mitigation alternatives. This process efficiently quantifies the performance of each alternative, including associated wetland restoration and sediment dredging needs where applicable, and provides a structured comparison based on relevant criteria. The study's purpose is to assist the City of Lakeland in selecting a preferred alternative that is feasible, beneficial, and sustainable while meeting grant requirements. Once the preferred alternative is identified and approved, it can be progressed to design, permitting, and ultimately implementation.

1.1 Project Location

Figure 1 Regional Location Map identifies the extent of the study limit and the Lake Bonnet Drain Project Reach, where improvements would occur to mitigate flooding for the May Manor Mobile Home Park and surrounding areas. More specifically, the area studied in detail as part of this project includes a reach of Lake Bonnet Drain beginning just upstream of North Wabash Avenue and extending upstream approximately 3,210 feet to North Brunnell Parkway. **Figure 2 Project Area Identification Map** illustrates the location of Lake Bonnet Drain in the study area and identifies other areas of consideration for the project, including Sterling Mobile Home Park.

1.2 Project Background

The Lake Bonnet Drain is a highly urbanized stream reach, which historically was part of a natural channel that served as the outlet for Lake Bonnet. The Lake Bonnet Drain from North Brunnell Parkway to North Galloway Road has a contributing drainage area of approximately 3.69 square miles and ultimately drains west to Itchepackesassa Creek. This 2.69-mile-long stream reach is characterized as having a mild slope of 0.15 percent and sluggish flow due to the numerous shallow pools throughout. Lake Bonnet Drain within the Project Reach (North Brunnell Parkway to North Wabash Avenue) has a stream length of approximately 3,210 feet and a slightly steeper net slope of 0.2 percent. Similarly, it can be characterized as exhibiting a sluggish flow due to having numerous shallow pools throughout.

Over the past one-half century, urbanization has resulted in increased stormwater runoff flow rates and volumes, and it has encroached into the floodplain areas with residential development and numerous road crossings throughout the reach. Several residential areas along the reach, including May Manor and Sterling Mobile Home Parks, located directly adjacent to the Lake Bonnet Drain channel, experience frequent flooding within their neighborhoods.

As is typical of Florida's urban stream systems, the historic Lake Bonnet Drain predates much of the urban development in the contributing drainage basin. Development, resulting in increased flow rates, runoff timing acceleration, and runoff volume, leaves the remnant channel with insufficient capacity to convey runoff at safe levels and causes severe channel erosion. A prior study investigating the cause of severe sedimentation in the Long Palm Golf Course ponds found that it was due to extensive stream bank erosion essentially along the 8,100-foot segment of Lake Bonnet Drain from North Brunnell Parkway downstream to the golf course. Lake Bonnet Drain's flooding problems are exacerbated by several issues that limit its conveyance capacity, including mild channel slope, excessive sediment buildup, flow restrictions at road crossings and an in-channel weir structure, and encroachment right up to the channel banks on each side. As highlighted in a prior feasibility study of May Manor flood relief, a significant portion of the development is in a low-lying area adjacent to the channel (bowl). **Figure 3 Project Area**

Topographic Map illustrates natural terrain within the Project Reach. As indicated on the FEMA Flood Insurance Rate Map (**Figure 4 Project Area FEMA Flood Hazard Map**), the Lake Bonnet Drain area from North Brunnell Parkway downstream to North Wabash Avenue is designated Flood Zone AE and includes a regulatory floodway. FEMA defines the regulatory floodway as such:

A regulatory floodway is defined as the channel of a river or other watercourse and the adjacent land area that is reserved from encroachment in order to discharge the base flood without cumulatively increasing the water-surface elevation by more than a designated height. NFIP regulations and Standard SID 69 and 70 state: "Floodway surcharge values must be between zero and 1.0 ft. If the state (or other jurisdiction) has established more stringent regulations, these regulations take precedence over the NFIP regulatory standard. Further reduction of maximum allowable surcharge limits can be used if required or requested and approved by the communities impacted.," and "If a stream forms the boundary between two or more states and/or tribes, either the 1.0-foot maximum allowable rise criterion or existing floodway agreements between the parties shall be used." The portions of the floodplain beyond the floodway are called the floodway fringe. The community is responsible for maintaining the floodway to mitigate flood hazards; the community must not allow any activities causing a rise in the Base Flood Elevation (BFE) in the regulatory floodway.

1.3 Project Funding

The City of Lakeland was awarded a $42.9 million grant from the DOC. The grant is facilitated through the U.S. HUD CDBG-MIT initiative as part of the Rebuild Florida Mitigation General Infrastructure Program. Grants were awarded to complete large-scale infrastructure projects to mitigate and harden against natural disaster risks, including severe flooding and hurricanes, targeting HUD and State-designated impacted and distressed areas.

Funding was provided by HUD through the State of Florida DOC to support long-term mitigation efforts following declared disasters in 2016 and 2017 through HUD's CDBG-MIT program. The funding was awarded competitively targeting HUD-designated Most Impacted and Distressed (MID) Areas, primarily addressing the Benefits to Low-to-Moderate Income (LMI) National Objective. Additional information may be found in the Federal Register, Vol. 84, No. 169. On April 16, 2021, the DOC selected the City to receive CDBG-MIT grant funds based on the Lake Bonnet Drainage Basin Flood Hazard and Debris Mitigation application submitted for the Rebuild Florida Mitigation General Infrastructure Program. The City entered into an Agreement with the DOC (Agreement# MT047) on October 27, 2022, to administer these disaster mitigation funds.

1.4 Project Schedule

The Lake Bonnet Drainage Basin Flood Hazard Mitigation Project has a very tight schedule, such that delays could potentially jeopardize the funding for this project. The construction of the proposed mitigation alternative is required to be completed by October 2028. A team of leading subject matter experts has been assembled to address potential obstacles and avoid project delays. The detailed schedule (provided in **Appendix A)** is a living document that will be regularly updated as the project advances through its various stages of development. Biweekly meetings between the City and the AECOM Project Team are held to provide updates and address technical items. Biweekly meetings are also held with the DOC to monitor the project's overall progress.

2. Feasibility Study Approach

Four conceptual alternatives were developed for the feasibility study based upon an understanding of the physical conditions within the Project Reach (see **Figure 2 Project Area Identification Map**). The analyses included identifying the causes and extent of flooding and understanding the project goals. Detailed descriptions of the alternatives are provided in **Section 5**.

The analyses utilized a hydrologic model program (StormWise) to analyze flood stages and flow rates for a series of design storm events. The hydrologic modeling was repeated to refine and optimize the design of each alternative's components to produce the best results within the limitations of that alternative. The components for the models were developed with the available data, such as aerial photography, high-resolution Light Detection and Ranging (LiDAR) topography, land surveys, hydrography, and other pertinent features. Details regarding the data collection of the existing features are provided in **Section 3**. **Figure 5 Hydrologic Model Domain** illustrates the location and extent of the model domain, and details of the hydrologic model studies are described in **Section 4**.

Results of the final design modeling for each alternative were used to develop floodplain boundaries and other pertinent tabular results, which were then used to evaluate the assessment components, including the following:

- Level of Service (LOS) Performance
- Offsite Impacts (flood levels and flows)
- Engineer's Opinion of Probable Cost (EOPC)
- Permit Issues, Mitigation Requirements, and Feasibility
- FEMA Compliance
- Property/ Right-of-Way (ROW) Requirements
- Constructability

Each assessment component is described in detail in **Section 6**. It is important to note that implementing flood mitigation features within the Project Reach may impact downstream areas in Lake Bonnet Drain west of North Wabash Avenue. To accurately assess potential downstream impacts, the StormWise hydrologic model domain, therefore, includes all headwater areas flowing to Lake Bonnet and extends downstream to North Galloway Road.

Finally, the results from the component assessments for each alternative were compared side by side to produce a relative ranking of the four alternatives. For example, the LOS achieved by each alternative was compared, with the alternative with the highest LOS receiving the top ranking and the lowest receiving the bottom ranking. The rankings for each component of the alternatives were assembled into a concise matrix to facilitate selecting a preferred alternative.

3. Data Collection /Existing Conditions

To develop a comprehensive analysis for the feasibility study, existing publicly available resources, and data were used and supplemented by field surveys (bathymetric survey, LiDAR topographic survey, wetland delineation, etc.) to collect data within the project vicinity. The City provided relevant information related to the project background and proposed action. This section provides a summary of the data collected from these various sources.

3.1 Hydrographic and Geophysical Survey

3.1.1 Bathymetric and Sediment Thickness Surveys

Arc Surveying & Mapping, Inc. (Arc) conducted a hydrographic and geophysical survey of Lake Bonnet to map the lake’s subsurface features. The survey utilized dual frequency sonar depth soundings (200/24 kHz) and electrical resistivity data collected simultaneously at 50-foot line spacing across the lake’s navigable areas. The dual frequency sonar identified the presence of suspended sediments (referred to as “fluff”). At the same time, the resistivity data provided insight into subsurface geological structures down to a depth of approximately 35 feet.

The survey data were processed and converted into a digital terrain model (DTM). These data and vibracore borings data from 2018 and LiDAR data detailing the ground surface elevation around the lake’s perimeter were integrated into an Integrated Digital Geological Model (IDGM). The model results indicated the presence of two distinct sediment basins within Lake Bonnet, separated by a sandy ridge. The eastern basin features relatively thick muck deposits overlying sand. In contrast, the western basin has thinner muck deposits on top of fat clay, with undefined high-resistivity structures at deeper levels and sandy deposits along the western shoreline.

The IDGM, combining boring data, bathymetric data, and resistivity information, is accessible via the ArcGeoTwin online platform. This model provides a detailed visualization of the location, extent, and thickness of the sediment features within Lake Bonnet. The comprehensive details on the survey methods, findings, and access information for the ArcGeoTwin platform are provided in **Appendix G Hydrographic and Geophysical Survey Reports.**

3.1.2 LiDAR Survey

AECOM drone pilots, certified by the Federal Aviation Administration (FAA), conducted an aerial survey of the study area from February 18, 2024, to February 23, 2024, by flying a USA-made Wattson Innovations Prism Sky octocopter drone holding a TrueView dual LiDAR and imagery sensor. The LiDAR point cloud was used to produce a digital elevation model, while the systematically collected photos were used to create an orthorectified aerial mosaic. The topographic survey data and the ortho-mosaic were utilized for the initial desktop delineation of natural resources (wetlands, surface waters, and undeveloped upland features) in the study area prior to conducting the field surveys.

3.2 Wetlands and Surface Waters

AECOM biologists identified and delineated wetlands and surface waters within the study area, including areas west of Galloway Road, between April 14, 2024, and April 27, 2024. A total of 18 wetland areas were identified and delineated.

Prior to field surveys, a desktop review of recent aerial photographs and other publicly available data was conducted to preliminarily identify wetlands and surface waters. The boundaries of wetlands and surface waters were ground-truthed and delineated using the current federal and state methodologies identified within the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (USACE 2010) and Chapter 62-340.300(2) of the Florida Administrative Code (F.A.C.). Wetland boundaries will be reviewed and approved by federal and state regulatory agencies during the permitting phase of the project.

Within the portion of the study area east of Wabash Avenue, nine wetland areas and two surface water areas were identified. Three wetland areas, wetland 12 (W12), wetland 13 (W13), and wetland 14 (W14) occur adjacent to or near the Lake Bonnet Drain channel. W12 is a man-made or artificial feature that was created as a floodplain compensation for the volume of fill needed to create a partial berm on the north side of the Lake Bonnet Drain channel. Although man-made, W12 will be considered as a wetland for regulatory purposes. Two wetland areas, wetland 15 (W15) and wetland 8 (W08), are associated with Lake Bonnet. Wetland area W11 is located near the proposed infiltration system, a design component of Alternative 4. Three wetland areas, wetland 9 (W09), wetland 10 (W10), and island 3 (I03), are associated with Bonnet Springs Park. Wetlands W09 and W10 have been classified as vegetated non-forested wetlands, with the remaining wetlands classified as forested wetland habitats. The two surface water areas include the Lake Bonnet Drain channel and the waters of Lake Bonnet, inclusive of the littoral zone of the lake.

Further discussion of wetland and surface water habitats is provided in the Biological Assessment Report (BAR) located in **Appendix H**.

3.3 Protected Species

AECOM biologists performed a desktop review of publicly available data to identify protected species that could occur within the study area based on habitats identified on site.

In conjunction with wetland delineations and additional field surveys, AECOM biologists performed pedestrian surveys to confirm the presence or absence of surveys of protected wildlife and plant species. The survey included both direct observations and indirect evidence, such as tracks, burrows, tree markings, and bird calls indicative of species presence. No species-specific wildlife surveys were conducted. Species-specific surveys may be a requirement of federal or state regulatory agencies during the permitting phase of the project.

Protected species observed on site were limited to federal and state-listed bird species. Only one federally protected species, the wood stork, was observed. Four state-protected bird species were also observed. These federal and state protected species were observed in areas west of Wabash Avenue. Although observations of these protected species occurred west of Wabash Avenue, wetlands and surface water habitats found within and near the Lake Bonnet Drain and Lake Bonnet can be used by these species. Therefore, although not directly observed, these species are assumed to use the wetlands identified east of Wabash Avenue.

Further discussion of protected species within the study area is provided in the BAR located in **Appendix H.**

3.4 Geotechnical

Madrid Engineering Group, Inc. conducted a geotechnical survey to assess subsurface soil and groundwater conditions along the Lake Bonnet Drain between North Wabash Avenue and North Brunnell Parkway. The primary objective was to evaluate the subsurface conditions at specific boring locations to identify any potential constraints these conditions might impose on planned improvements.

The scope of the investigation included reviewing existing geological data, conducting field exploration and laboratory testing, analyzing soil testing results, and providing general geotechnical recommendations for proposed improvements. The study reviewed a topographic survey map from the U.S. Geological Survey, revealing that the natural ground surface elevation at the project site ranges from +140 feet to +145 feet (NAD 1983).

According to the Natural Resources Conservation Services (NRCS) Soil Survey for Polk County, the predominant shallow soils along the project corridor are Samsula muck, Yakka-Immokalee-Urban land complex, and Arents, organic substratum-Urban land complex. Subsurface exploration included drilling four 25-foot-deep Standard Penetration Test (SPT) borings and nine 15-foot-deep SPT borings along the banks of the channel. The soils encountered consisted primarily of varying densities of sands to clayey sands, with occasional layers of soft to stiff lean clay, stiff plastic clay, and organic soils. Groundwater was found in all but one of the borings at depths ranging from one to nine feet below the existing grade. Laboratory testing revealed variations in soil properties, including particle size distribution, moisture content, organic content, liquid limit, plastic limit, and plasticity index.

The geotechnical survey findings informed recommendations for culvert foundations, below-grade walls, site preparation, fill suitability, soil compaction, shallow excavations and dewatering, slope stabilization, drainage, and sheet pile embedment. These recommendations were considered in developing and assessing the feasibility of flood mitigation alternatives. Detailed underground exploration results and the geotechnical recommendations are included in **Appendix I**. Hydrologic Model Studies.

This section documents the hydrologic model studies conducted to estimate existing conditions and proposed conditions for each of the four alternatives throughout the model network (domain). **Figure 5 Hydrologic Model Domain** illustrates the location and extent of the model study area. The model domain includes the entire Lake Bonnet Drainage Basin area, which is comprised of areas located upstream of the Project Reach and areas downstream of the Project Reach (west of North Wabash Avenue) to the terminus of Lake Bonnet Drain at North Galloway Road. This is required to assess potential offsite impacts that may result from the implementation of a particular alternative.

The hydrologic models are the basis of the feasibility study, providing information such as the existing and proposed condition flood elevations, flow rates, and floodplain boundaries. Model results and the conceptual plans for developing the alternatives were used to inform each assessment component.

4. Hydrologic Model Studies

This section documents the hydrologic model studies were conducted to estimate existing conditions and proposed conditions for each of the four alternatives throughout the model network (domain). **Figure 5 Hydrologic Model Domain** illustrates the location and extent of the model study area. The model domain includes the entire Lake Bonnet Drainage Basin area, which is comprised of areas located upstream of the Project Reach and areas downstream of the Project Reach (west of North Wabash Avenue) to the terminus of Lake Bonnet Drain at North Galloway Road. This is required to assess potential offsite impacts that may result from the implementation of a particular alternative.

The hydrologic models are the basis of the feasibility study, providing information such as the existing and proposed condition flood elevations, flow rates, and floodplain boundaries. Model results and the conceptual plans for development of the alternatives were used to inform each of the assessment components.

4.1 Model Basis

Flooding in the Lake Bonnet Drain system has been the focus of several drainage studies in the past. The initial study, “Lake Bonnet Drain Study,” was produced by Keith and Schnars, P.A. in December 2004 for the City of Lakeland and the Southwest Florida Water Management District (SWFWMD). The most recent study, “Lake Bonnet Drain May Manor Flood Relief Feasibility Study,” was produced by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec) in November 2017 for the City of Lakeland. The Amec study built upon the initial study, expanding the model domain and updating the previous study’s model elements.

The Lake Bonnet Drainage Basin Flood Hazard Mitigation Project utilizes the existing condition hydrologic model (ICPR3) and limited model development data from the Amec November 2017 Study as a basis for the existing condition model studies and subsequent alternative model assessments for the Project. An electronic version of the model and supporting data (GIS files) were provided by the City of Lakeland.

4.2 StormWise Model Updates

Electronic versions of the ICPR3 model and GIS files were used as a basis for the hydrologic models developed for the Project. The following details the procedures utilized to develop the hydrologic models used in the feasibility study.

4.2.1 ICPR3 Model Conversion and Verification

The ICPR3 model (existing conditions 2017) was converted to the StormWise model using the conversion utilities available within the model software. The StormWise model software is the latest rebranded version of ICPR available through Streamline Technologies of Winter Springs, Florida. Minor corrections were required as part of the conversion process, and the model was executed for a series of design storm events, including the 2.33-year (mean annual), 10-year, 25-year, and 100-year frequencies. Model input data for each model element (Basins, Nodes, Channels/ Cross-Sections, Links, etc.) were then verified against input data printouts available within the Amec 2017 study report. Additionally, model results, such as the predicted peak flood elevations and flow rates, were compared against tabular and graphical data presented in the Amec report. This procedure was intended to verify that the converted model represents the existing conditions as documented in the Amec 2017 study report. The verified existing conditions of the StormWise model (Base Model) then served as the basis for model development for the feasibility study.

4.2.2 StormWise Model Update - Network Development

The ICPR3 Base Model represents existing conditions circa 2017. Additionally, the geographic information system (GIS) based model development data were very limited, consisting only of subbasin boundaries and cross-sections. For this Project, the StormWise model was updated to present-day conditions using the latest high-resolution digital elevation data (LiDAR), aerial photography, land survey (cross-sections, bridges, structures, etc.) hydrographic survey data for lakes within the model domain, and updated soils and land use information.

GIS was used to create a spatially correct model network for all model elements, including Basins, Nodes, Channels/ Cross-Sections, and various Links types. Basin/ subbasin boundaries were updated using the latest topographic data. Basin-related hydrologic input parameters (Curve Number, Time of Concentration, etc.) were updated based on the revised subbasin boundaries and the latest land use data. Note that subbasin refinements were also made to reflect new features, such as the Lagoon and certain ponds in the Bonnet Springs Park area. **Figure 6 Hydrologic Model Schematic - Basin Elements** illustrates and identifies the updated Subbasin elements throughout the model domain.

Node elements representing lakes, ponds, and basin depressional storage were updated using the latest topographic (LiDAR) survey and hydrographic data. Revisions generally consisted of refined stage volume relationships, essential to estimating flood elevation and discharge rates throughout the drainage system. Note that additional nodes were added to the model network to reflect new features, such as the Lagoon and certain ponds in the Bonnet Springs Park area. **Figure 7 Model Hydrologic Schematic - Node Elements** illustrates and identifies the updated Node elements throughout the model domain.

Updated Channel/ Cross-Section elements reflect a major refinement in the project's modeling methodology. The updated model places a major influence on high accuracy open-channel modeling within the Project Reach from North Wabash Avenue to North Brunnell Parkway. This was accomplished by adding a significant number of cross-sections within the reach, expanding their extent (to cover possible floodplain limits), and most importantly, using the land survey and hydrographic data to represent true channel geometry below the water line. This refinement is necessary to verify the highest level of accuracy in estimating flood elevations and flow rates in the area where the proposed alternatives are located. **Figure 8 Hydrologic Model Schematic - Channel Elements** illustrates and identifies the updated Node elements throughout the model domain.

Finally, link elements, including pipes, weirs, and drop structures, representing the connections between nodes and cross-sections, were updated using the latest topographic (LiDAR) and survey data. Revisions generally consisted of adding newly acquired pipes information (i.e., size, material, length), and revisions to overland flow type weir geometry based on the latest topographic data. Note that a number of additional pipe and weir links were added to the model network to reflect new features, such as the Lagoon and certain ponds in the Bonnet Springs Park area. **Figure 9 Hydrologic Model Schematic - Link Elements (Excluding Channels)** illustrates and identifies the updated link elements throughout the model domain.

4.2.3 Updated Existing Condition StormWise Model

The updated model network development data were entered into the existing condition hydrologic StormWise model. The model was run for a series of design events, including the 2.33-year (mean annual), 10-year, 25-year, and 100-year frequencies. The model results were compared to results from the Amec 2017 study and to FEMA flood boundary data via the project GIS data. These comparisons were intended to verify consistency with the previous study and FEMA flood boundary results and provide a plausible explanation of where the results differed. The updated StormWise Model Input, provided as **Appendix F StormWise Model Input Documentation**, includes full details of input data for the project's existing condition. Due to the large file size, the appendix is provided under a separate cover.

4.3 Alternatives Model Development

The existing condition StormWise model was used as a basis for the development of hydrologic models for each of the four (4) proposed alternatives. The existing condition model contains the majority of the model elements required for the proposed alternative models, with the exception of links representing pump rating curves that are necessary for the Alternatives 3 and 4 models. **Section 5** of this report provides a detailed description of the four (4) alternatives. **Figures 10 through 16** provide the site layout for each of the alternatives. A model for each alternative was developed by updating the existing condition model to include the proposed features for the particular model. It is important to note that the development of the alternatives is an iterative process where plan features were modified based on modeling results to produce an alternative plan with optimal results in meeting flood mitigation goals. As with the existing condition model, full details of input data for each proposed alternatives are provided in **Appendix F StormWise Model Input Documentation**. The final models were executed for a series of design events, including the 2.33-year (mean annual), 10-year, 25-year, and 100-year storm frequencies.

4.4 Model Results

The results of the existing condition modeling and final design modeling for each alternative were used to develop floodplain boundaries and other pertinent tabular results (data), which were then used to evaluate the assessment components.

Appendix C Model Results Node Stage and Flow Comparison provides a detailed summary of model results (by flood frequency) for each model nodes illustrated in **Figure 7 Hydrologic Model Schematic - Node Elements**.

5. Description of Alternatives

As detailed in the CDBG-MIT Grant application, the Lake Bonnet Drainage Basin Flood Hazard Mitigation Project considered the following combination of improvements within the Lake Bonnet Drain system:

- Removal of the Sterling Mobile Home Park Weir
- Upsizing two culverted road crossings (May Manor Road and Bridge Boulevard)
- Excavating/ deepening Lake Bonnet Drain channel
- Installing flood walls and sump pumps along the Lake Bonnet Drain channel
- Installing a pump station to pump flood water into Lake Bonnet
- Embankment improvements on North Brunnell Parkway abutting Lake Bonnet (as necessary)

Based on the proposed improvements, four flood mitigation alternatives were developed and evaluated as part of the feasibility study. These alternatives were developed using topographic and bathymetric surveys, as well as LiDAR and environmental survey data. Each alternative was assessed for hydraulic performance to determine the level of effectiveness (LOS) at reducing or eliminating flood risk within the project study area.

This section provides detailed descriptions of each proposed alternative, including a summary of components, plans, profiles, cross-sections, and an indication of property/ROW requirements. The following are the four alternatives:

- **Alternative 1:** Channel Improvement (Berms and Floodwalls)
- **Alternative 2:** Channel Improvement (Floodwalls)
- **Alternative 3:** Backpumping to Lake Bonnet
- **Alternative 4:** Detention (Pond/ Underground Storage)

5.1 Alternative 1 – Channel Improvement (Berms/Floodwalls)

The channel improvement alternative is shown in **Figure 10 Alternative 1 - Channel Improvement (Berms/Floodwalls)**. This alternative includes channel improvements for a 3,210-foot-long segment of Lake Bonnet Drain beginning just upstream of North Wabash Avenue and extending upstream to North Brunnell Parkway.

This alternative seeks to utilize increased channel conveyance to lower flood stages in the May Manor and Sterling Park reaches of Lake Bonnet Drain but will require sump pump stations to convey stormwater runoff from local drainage to the channel. Increased conveyance may result in increased streamflow rates in downstream areas of Lake Bonnet Drain, with downstream rates increasing as the level of service increases.

The following are the proposed improvements for Alternative 1:

- Excavate/deepen the Lake Bonnet Drain channel
- Regrade/flatten the channel profile (see **Figure 11 Proposed Channel Profile and Cross-Sections**) to provide a uniform and more efficient slope, and reconfigure channel cross-section side slopes (2H:1V or less steep) to increase channel stability, and using revetment in areas as necessary (side slopes are dependent on available channel width, the overall goal is to maximize channel bottom width)
- Remove the unpermitted Sterling Weir
- Upsize two culverted road crossings at May Manor and Bridge Boulevard
- Possibly raise existing berms (levees) as necessary and potentially add additional berms at locations presently without berms
- Provide sumps and pumps on the landward side of berms to facilitate drainage from local areas into the channel

- Provide electric connection and backup power for the sump pump systems
- Improve local drainage system to intercept and convey stormwater runoff to sump pump systems
- Acquire ROW for access and maintenance purposes
- Pipe the open channel section of Sterling Canal with a backflow preventer at the confluence of Lake Bonnet Drain channel
- Modify the Lake Bonnet outlet control sluice gates to open from the top instead of from the bottom

5.2 Alternative 2 – Channel Improvement (Floodwalls)

The channel improvement alternative is shown in **Figure 12 Alternative 2 - Channel Improvement (Floodwalls)**. This alternative includes channel improvements with floodwalls and associated sump pump stations for a 3,210-foot-long segment of Lake Bonnet Drain beginning just upstream of North Wabash Avenue and extending upstream to North Brunnell Parkway. The floodwalls aim to prevent surface runoff from flowing directly to or through existing storm pipes into the channel. As such, sump pump stations will be needed on both sides of the channel to convey local drainage into the Lake Bonnet Drain.

This alternative seeks to isolate flood stages in the Lake Bonnet Drain channel from the May Manor and Sterling Park areas by constructing floodwalls to an elevation consistent with the desired LOS. The revised channel cross-sectional configuration (vertical side slopes due to floodwall) will act to maximize the conveyance capacity within the proposed reach. Increased conveyance may result in increased streamflow rates in downstream areas of Lake Bonnet Drain, with downstream rates increasing as the level of service increases.

The following are the proposed improvements for Alternative 2:

- Construct floodwalls on both sides of Lake Bonnet Drain throughout the proposed reach as necessary (extent and height) to provide a desired level-of-service
- Regrade/ flatten the channel profile (see **Figure 11 Proposed Channel Profile and Cross-Sections**) to provide a uniform and more efficient slope
- Remove the unpermitted Sterling Weir
- Upsize two culverted road crossings at May Manor and Bridge Boulevard
- Raise existing floodwalls as may be necessary to meet the desired LOS
- Provide sumps and pumps on the landward side of berms/ floodwalls to facilitate drainage from local areas into the channel
- Provide electric connection and backup power for the sump pump systems
- Improve local drainage system to intercept and convey stormwater runoff to sump pump systems
- Acquire ROW for access and maintenance purposes
- Pipe the open channel section of Sterling Canal with a backflow preventer at the confluence of Lake Bonnet Drain channel
- Modify the Lake Bonnet outlet control sluice gates to open from the top instead of from the bottom

5.3 Modify the Alternative 3 – Backpumping to Lake Bonnet

The Backpumping to Lake Bonnet alternative is shown in **Figure 13 Alternative 3 – Backpumping to Lake Bonnet**. This alternative includes a pump station located immediately downstream of the Lake Bonnet outlet control structure adjacent to North Brunnell Parkway. This alternative also includes: (1) channel improvements for a 3,210-foot-long segment of Lake Bonnet Drain beginning just upstream of North Wabash Avenue and extending upstream to North Brunnell Parkway (**Figure 14 Alternatives 3 - Proposed Channel Profile and Cross-Sections**).

The channel profile will be dredged with a negative slope to collect the stormwater in the Lake Bonnet Drain. The accumulated stormwater will be conveyed to the pump station and pumped into Lake Bonnet. A force main is required to cross North Brunnell Parkway to discharge the stormwater to Lake Bonnet. Stormwater pumped to Lake Bonnet will subsequently be released at a lowered rate back into the Lake Bonnet Drain channel, allowing the lake to return to normal water levels. Note that channel improvements include only regrading from the existing top of bank to support the channel profile geometry. No berms (levees) are proposed as part of this alternative. A limited number of floodwall sections will be required at channel transition locations for road crossings and the Lake Bonnet control structure.

In addition, two sump pump stations will be needed in low areas to convey local drainage into the Lake Bonnet Drain channel.

The following are the proposed improvements for Alternative 3:

- Construct a stormwater pump station with a capacity sufficient to lower peak discharge rates and stages within the Lake Bonnet Drain to safe levels (mitigate flooding) to meet the desired LOS.
- Construct a pipe system to convey pumped stormwater to Lake Bonnet. This system will need to be routed through the North Brunnell Parkway embankment and include terminal structures at the inlet and outlet ends. The length of the pipe system will be dependent on the actual location of the pump station and is expected to be approximately 250 feet.
- Provide required electric power for the pump station.
- Since this pump station is a flood control facility, an emergency generator will be needed to operate the pump station in the event of a power outage.
- Implement modifications to the channel and other facilities (Sterling Weir) that allow stormwater runoff in the proposed reach to be pumped to Lake Bonnet. Improvements will include re-grading the channel bottom to provide an adverse bottom slope and/or modifying the Sterling Weir to impound water to a sufficient depth to allow pumpage at the required rates, see **Figure 14 Alternatives 3 - Proposed Channel Profile and Cross-Sections**.
- Pipe the open channel section of Sterling Canal with a backflow preventer at the confluence of the Lake Bonnet Drain channel.
- Acquire easements for access and maintenance purposes.
- Revise the Lake Bonnet operating schedule to maintain normal water levels 1-foot lower than the present level (EL. 144 feet). In order to create the additional storage volume required to accommodate backpumped volumes from Lake Bonnet Drain, the desired normal pool level of the lake should be EL. 143 feet.
- Regrade the Lake Bonnet shoreline to maintain existing slopes after water level lowering.
- Provide revetment as necessary to stabilize the North Brunnell Parkway embankment adjacent to Lake Bonnet.
- Restore/replant wetland and shoreline vegetation that are lost due to lake level lowering.
- Bonnet Springs Park Lagoon mitigation may be required to address impacts due to lake level lowering.
- Dredge lake sediments to account for lowered normal lake levels.
- Modify the Lake Bonnet outlet control sluice gates to open from the top instead of from the bottom

5.3.1 Dredging of Lake Bonnet for Flood Storage

A Dredging and Dewatering Alternatives Analysis in **Appendix J** has been prepared in support of Alternative 3 to lower the current water level elevation to increase the hydraulic storage volume of Lake Bonnet. The analysis is intended to determine and recommend a cost-effective design to remove and subsequently manage sediments in an ex-situ sediment management facility (SMF) area for in-situ/ex-situ beneficial reuse opportunities.

The AECOM dredge design team evaluated alternatives and recommended the dredging and dewatering alternative(s) that best-achieved project objectives and assisted the City of Lakeland with its overall restoration goals for Lake Bonnet. The analysis incorporates a sediment management strategy into the overarching flood hazard mitigation program. It also provides an analysis of alternatives for removing approximately 143,000 cubic yards (CY) of sediment accumulated throughout the years in Lake Bonnet (**Figure 1 Sediment Volume to be Removed** in **Appendix J**).

Sediment removed from the lake will be contained, dewatered, consolidated in a temporary lakeside confined disposal facility(ies) (CDF); and beneficially reused. Opportunities to beneficially reuse “clean” sediment onsite for wetlands and littoral zone restoration or offsite (e.g., landfill cap material) within the watershed or other applications will be evaluated. A recent delineation of the Lake Bonnet wetland (**Appendix H Biological Assessment Report**) identified that the flooded hardwood forest was of higher quality than originally assessed, and the cost of mitigation could be expensive if part of the wetlands were temporarily disturbed and used for dredging and dewatering activities. Additional CDF locations for sediment management may need to be assessed if a temporary disturbance is not feasible.

Note that only preliminary sediment characterization, chemistry, and lithology (e.g., thickness of organic layer) have been investigated to date. A more thorough investigation is scheduled for fall 2024 to delineate the quantity/quality of sediment within the dredge prism. This effort is being performed in concurrence with the most recent City of Lakeland Water Quality Management Plan (2019).

The following dredging and dewatering alternatives were selected for definitive evaluation utilizing previous project experience:

- Alternative 1 – No Action
- Alternative 2A – Mechanical Dredging with Amended Sediment Stacking
- Alternative 2B – Mechanical Dredging with Mechanical Dewatering
- Alternative 2C – Mechanical Dredging with Passive Dewatering (stacking)
- Alternative 3A – Hydraulic Dredging with a CDF
- Alternative 3B – Hydraulic Dredging with Geotextile Tube Dewatering
- Alternative 3C – Hydraulic Dredging with Mechanical Dewatering

The alternatives were initially evaluated against criteria including technical feasibility (i.e., constructability, effectiveness, sustainability), economic feasibility, and other considerations (e.g., regulatory and community acceptance). Scoring each alternative was completed by assigning an equitable value (1-20) to each criterion for each alternative. Alternatives were scored using past engineering experience, historical data, and previous alternatives analysis workshops with the City of Lakeland, Bonnet Springs Park, and other community stakeholders. Values were summed to create a total score for each alternative.

Based on the following Alternatives Analysis Scoring **Table 1 in Appendix J**, the Alternative 3A – Hydraulic Dredging with a CDF is recommended over mechanical dredging and other dewatering alternatives. The comparison and rationale used to perform the scoring analysis are summarized in **Tables 1 and 2 in Appendix J**. The EOPC for this dredging and dewatering approach for 143,000 CY of in-situ sediment (30% solids) was estimated at approximately $7,373,073 (-30% to +50%).

A Data Gap Investigation is recommended to confirm assumptions. Additional sampling will be required to further delineate contaminants of concern (COCs) throughout the lake, followed by a bench-scale treatability study to characterize and test dewatering efficacy of lake sediments. A CDF and/or SMF location should be determined prior to beginning any detailed designs. If dredging is selected to be included as part of the flood mitigation project, a complete basis of design report (BODR) will be drafted once data gaps have been completed and permit applications submitted. In addition, dewatered sediment characterization and beneficial use opportunities for onsite reuse will be evaluated throughout the design process. Beneficial use alternatives such as shoreline or littoral zone placement, wetland rehabilitation, and/or land creation within the lake may provide cost/benefit to the Lake Restoration Program and simultaneously limit offsite transportation and disposal costs.

5.4 Alternative 4 – Detention (Pond/ Underground Storage)

The Detention (Pond/ Underground Storage) alternative comprises of detention storage facilities. As illustrated in **Figure 15 Alternative 4 - Detention (Pond/ Underground Storage)**, this alternative includes the construction of a stormwater detention pond, three buried storage vault systems, and associated pump systems for inflow and discharge control. Two vault systems are to be located within the Lake Bonnet Drain channel proper, and one system will be located adjacent to and north of the channel. Also illustrated is a stormwater detention pond located on the present site of the McKeel Academy of Technology School on the north side of May Manor Mobile Home Park. This alternative will not require modifications to the Lake Bonnet Drain channel profile or cross-section geometry except for the installation of the vault systems, as illustrated in **Figure 16 Alternatives 4 - Proposed Channel Profile and Cross-Sections**).

This alternative seeks to lower flood stages in the Lake Bonnet Drain channel and surrounding areas within May Manor and Sterling Park by utilizing detention storage timed to lower peak flow rates in the channel and reduce stormwater discharge volumes. Decreased peak rates and volume reduction may result in decreased streamflow rates in downstream areas of Lake Bonnet Drain.

The following are the proposed improvements for Alternative 4:

- Construct three underground detention vault systems at the location and to the size as shown in **Figure 15 Alternative 4 - Detention (Pond/ Underground Storage)**
- Construct associated inflow and discharge control pump systems for each of the underground detention vaults
- Construct a stormwater detention pond system (5ac, MOL) and associated structural control and pipe conveyance systems as shown in **Figure 15 Alternative 4 - Detention (Pond/ Underground Storage)**
- Since these pump systems are flood control facilities, an emergency generator will need to be included to operate each of the pump stations in case of a failure of commercially available power
- Pipe the open channel section of Sterling Canal with a backflow preventer at the confluence of Lake Bonnet Drain channel
- Acquire property to locate the off-channel vault system and pump station facilities, including the emergency generator
- Acquire easements for access and maintenance purposes
- Modify the Lake Bonnet outlet control sluice gates to open from the top instead of from the bottom

6. Assessment Components

A feasibility study is conducted to assess the practicality and potential success of a proposed project with the following key goals:

- **Evaluate Viability:** It determines whether the project is likely to succeed by analyzing various factors such as technical, economic, legal, and operational aspects.
- **Identify Potential Issues:** It helps uncover potential problems and challenges that could arise during the project's implementation.
- **Assess Costs and Benefits:** It evaluates the costs required and the value or benefits to be attained, verifying that the project meets stated objectives and cost constraints.
- **Support Decision-Making:** It provides essential information to project stakeholders, helping them make informed decisions about whether to proceed with the project.

To meet the key goals, the feasibility study included an assessment of each potential factor (Assessment Component) that may impact or may be impacted by the Project. The Assessment Components are as follows:

- Level of Service (LOS) Performance
- Offsite Impacts (flood levels and flows)
- Engineer's Opinion of Probable Cost (EOPC)
- Permit Issues, Mitigation Requirements, and Feasibility
- FEMA Compliance
- Property/ Right-of-Way (ROW) Requirements
- Constructability

6.1 Assessment Components Description

The alternatives assessment is comprised of two elements:

- General description of each of the assessment components (**Section 6**)
- Detailed assessments of each alternative by individual assessment component (**Section 7**)

The two elements are designed to provide the data and information necessary to allow the City of Lakeland to make an informed decision on selecting a preferred alternative.

6.1.1 Level of Service (LOS) Performance

The LOS Performance assessment component is intended to determine each alternative's success at mitigating flood hazards within the Project Reach. Assessment studies also provide a basis for comparing the performance of each alternative against the others. The LOS for each alternative is determined from the results of hydrologic modeling studies. Estimated flood stages for each of the modeled flood frequencies were used to develop floodplain boundaries, which were plotted against existing condition flood boundaries (also developed from modeling studies). Existing and proposed condition floodplain boundaries were plotted together using GIS software to determine the difference in the number of affected structures by comparing the number of affected structures under each alternative condition.

Depending on the results of the impact studies, each alternative was correlated to a LOS consistent with one of the simulated flood frequencies, i.e., 2.33-year, 10-year, 25-year, or 100-year. As discussed previously, this process was used to optimize each alternative's performance to attain the highest LOS. The LOS Performance assessment also produced a set of tables designed to compare flood stage reduction and structure impact reduction within the Project Reach. The LOS estimate for each alternative is used in direct comparison to rank the alternatives against each other, providing the information necessary to allow the City of Lakeland to make an informed decision on selecting a preferred alternative.

6.1.2 Offsite Impacts (flood levels and flows)

Implementation of the proposed alternatives has the potential to affect offsite flood elevations and flow rates within the hydrologic model network (see **Figure 5 Hydrologic Model Domain**). Depending upon location, these effects could be a reduction or an increase in peak elevations, peak flow rates, or both. The Offsite Impacts assessment was conducted to quantify resultant changes in peak flood elevations and flow rates. When used in conjunction with floodplain boundary mapping, it was used to facilitate the determination of potential impacts due to those changes. The estimated peak flood stages and flow rates for existing conditions and for each alternative were determined based on the results of the hydrologic modeling studies.

To facilitate the assessment of offsite impacts, a set of tables was produced to compare flood stage and flow rate changes within the entire model domain. In addition, a series of figures were created to illustrate the location and type of change, such as peak flood elevation increase, peak flow rate increase, both flood elevation and flow rate increase, and no increase. The tables and figures are provided and further described in **Section 7.1.2**. The Offsite Impacts assessment for each alternative is used in direct comparison to rank the alternatives against each other, providing the information necessary to allow the City of Lakeland to make an informed decision on selecting a preferred alternative.

6.1.3 Engineer’s Opinion of Probable Cost (EOPC)

Engineer’s Opinion of Probable Cost has been developed for each of the alternatives presented in the feasibility study. The estimated project scope only includes items detailed in the conceptual plans for each alternative, as shown in **Figure 10** through **Figure 16**.

The EOPCs have been prepared based on an AACE class 4 estimate, and the estimates include a contingency to account for design development. All unit costs presented include labor burden, subcontractor markups, material and equipment tax, and escalation.

The EOPCs for each of the alternatives are provided in **Appendix D**.

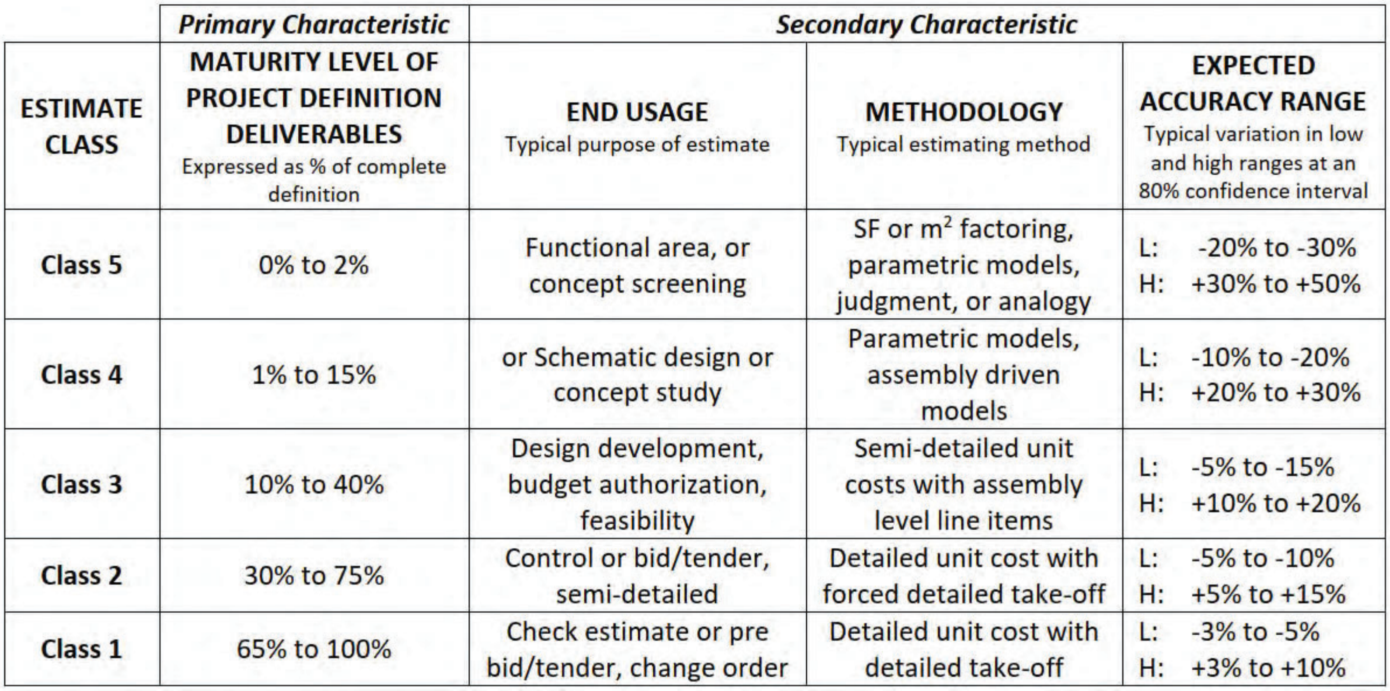
6.1.3.1 Estimating Methodology

The estimates were developed using the historic bid data for similar projects and RS Means data base unit prices for similar bid items. The historic unit prices were evaluated for project quantity and project conditions. The baseline for production rates, labor cost, material cost, and equipment cost were established using the RS Means 2024 cost database and Florida Department of Transportation (FDOT) statewide average unit prices. These costs were then adjusted based on project location, scope of work, year of construction, and accessibility of the work item. The quantities for the cost estimate were derived from detailed quantity takeoff and plan computation quantities.

6.1.3.2 Estimating Classification

Table 6-1 shows that with increasing project definition, the range of expected accuracy for a cost estimate decreases from Class 5 to Class 1. This estimate is an American Association of Cost Estimating (AACE) Class 4 estimate with an expected accuracy range of -15% to +50% at an 80% confidence level (**Table 6-1**). The planning and design deliverables support this classification at a feasibility study design level. As detailed in the contingency section below, the estimates have been developed with a 50% design contingency.

Table 6-1 AACEI Cost Estimate Classification Table



	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	Functional area, or concept screening	SF or m^2 factoring, parametric models, judgment, or analogy	L: -20% to -30% H: +30% to +50%
Class 4	1% to 15%	or Schematic design or concept study	Parametric models, assembly driven models	L: -10% to -20% H: +20% to +30%
Class 3	10% to 40%	Design development, budget authorization, feasibility	Semi-detailed unit costs with assembly level line items	L: -5% to -15% H: +10% to +20%
Class 2	30% to 75%	Control or bid/tender, semi-detailed	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	Check estimate or pre bid/tender, change order	Detailed unit cost with detailed take-off	L: -3% to -5% H: +3% to +10%

6.1.3.3 Planning Basis

The cost estimates were developed assuming the project would be a design/bid/build with five or more bidders. The cost estimates utilize a five-day work week and eight-hour day work schedule, and they do not include extra costs for personnel overtime. The Notice to Proceed date for construction is anticipated to occur in January 2026 and end in December 2027 for an overall project duration of two years.

6.1.3.4 Cost Basis

The detailed cost estimates were generated using historical unit prices based on the RSMeans 2024 cost database and FDOT statewide average unit prices.

The escalation rate from the current date (September 2024) to the midpoint of construction (December 2026) is established at 5.6% annually.

6.1.3.5 Exclusions

- Estimates do not include escalation factors beyond the midpoint of construction.
- Estimates do not include risk contingency.
- Estimates do not include the cost of extended lead times on equipment.
- Estimates do not include Owner Contingency.

6.1.3.6 Contingencies

- Design Contingency has been set to 50% because the plans are at a feasibility study level.
- Owner Contingency is not accounted for in this estimate.

6.1.3.7 Risks

- Long lead times for permanent materials extending the project duration.
- Material price volatility causes equipment, fuel, or material prices to increase further than the escalation index.
- Inefficiencies due to working in an active waterway with seasonal restrictions and in proximity to residential neighborhoods.
- Access and staging for construction due to the proximity of private properties will be challenging, resulting in complications and increases in cost and time.

- An allowance of $500,000 for relocation of existing utilities has been included in the estimate; however, it is subject to change and will need to be refined as the design progresses based on the project scope and the anticipated utility conflicts,
- An allowance of $700,000 for property acquisition has been included in the estimate; however, it is subject to change based on actual project access and staging requirements.
- The cost estimate does not include any restoration of existing properties or features outside of the project limit, which might be required based on actual access and staging requirements.

6.1.4 Permit Issues, Mitigation Requirements, and Feasibility

All alternatives considered would require authorization from federal, state, and local regulatory agencies. Regulatory agencies evaluate impacts based on the amount of direct and indirect impacts on natural resources, particularly on wetlands and surface waters. As the number and/or significance of project impact(s) grows, so may the overall review time and/or level of studies/documentation necessary to obtain an authorization.

A United States (U.S.) Army Corps of Engineers (USACE) Standard permit (also known as an Individual Permit), SWFWMD Individual Environmental Resource Permit (ERP), and City of Lakeland tree permit are anticipated to be required for all alternatives. A brief discussion of each permit is provided below. Further discussion of permitting requirements is provided in the Biological Assessment Report (BAR) in **Appendix H**.

6.1.4.1 USACE Standard Permit

Section 404 of the Clean Water Act (CWA) requires authorization from the USACE for the discharge of dredged or fill material into any Waters of the U.S., including wetlands. As such, the CWA would apply to actions that result in temporary or permanent impacts on wetlands and surface waters. The need for this permit would be triggered by filling or dredging activities within the Lake Bonnet Drain channel and within Lake Bonnet, as these are considered waters of the U.S. as they have a direct surficial connection downstream with Tampa Bay and the Gulf of Mexico. A fundamental principle of Section 404(b)(1) states that dredged or fill material should not be discharged into wetlands and other waters unless it can be demonstrated that the discharge will not have unacceptable adverse impacts on those waters. An applicant must demonstrate that alternatives that lessen environmental impacts to achieve the project purpose have been considered and that compensatory mitigation is provided for unavoidable wetland impacts.

Submittal of a USACE permit application will necessitate consultations with the USACE and other consulting federal agencies, including the U.S. Fish and Wildlife Service (FWS) and the State Historic Preservation Office (SHPO). The FWS will be consulted for potential impacts on terrestrial and freshwater wildlife species protected under the Endangered Species Act (ESA). The purpose of the consultation is to ensure the project will not jeopardize the continued existence of any endangered or threatened species or result in the adverse modification of critical habitat of endangered or threatened species.

The SHPO will be consulted for potential impacts to cultural resources. Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to consider the impacts of their undertakings on historic properties and archeological resources. In Florida, the Florida Division of Historical Resources (FDHR) acts as the SHPO to identify and protect historic buildings, districts, structures, and archaeological sites in the State.

The USACE standard permit applications go through a maximum 30-day public notice period where the USACE will present the project and solicit comments from interested parties. Interested parties will include adjacent property owners, federally recognized Native American tribes, and organizations that have requested notification from the USACE.

Through the design phase of the preferred alternative, the type of USACE permit required will be re-evaluated. If the area of the impacts is determined to be 0.5 acres or less and the impacts will not jeopardize the continued existence of threatened and endangered species, then the project may qualify for permitting under a Letter of Permission or Nationwide Permit. Both permitting routes typically, but not always, have processing times that are less than a standard permit.

6.1.4.2 Southwest Florida Water Management District

An ERP is required for development or construction activities to prevent flooding, protect the water quality of Florida's lakes and streams from stormwater pollution, and protect wetlands and other surface waters. The ERP program regulates activities in, on, or over surface waters or wetlands, as well as any activity involving altering surface water flows within the State. The SWFWMD will review the project’s direct, secondary, and cumulative impacts on wetlands and surface water. Similar to the federal review, an applicant must demonstrate that project impacts have been eliminated or reduced to the greatest extent practicable. The SWFWMD will also consult with the Florida Fish and Wildlife Conservation Commission (FWC), the State agency designated to protect wildlife species, and the FDHR for cultural resources. Unavoidable wetland impacts will require compensatory mitigation.

Through the design phase of the preferred alternative, the type of State permit required will be re-evaluated to determine if the project could be completed under a General Permit, which would require less processing time.

6.1.4.3 City of Lakeland

The City of Lakeland regulates impacts on upland trees for local regulations. A Tree Removal permit is required to remove any tree over five inches in diameter including diseased, damaged, or standing dead trees known as snags. The City of Lakeland also has special protection for trees of specific species, age, and size known as heritage trees. The need for a tree removal permit will be further evaluated as the preferred alternative is carried through to the design and permitting phase.

6.1.4.4 HUD's NEPA Compliance Process

The National Environmental Policy Act (NEPA) requires Federal agencies to consider the environmental effects of undertaking any action through a systematic interdisciplinary approach. The NEPA implementing regulations are detailed in Title 40 of the Code of Federal Regulations (CFR) Parts 1500-1508. HUD's decision-making process under NEPA is detailed in 24 CFR. Specifically, 24 CFR Part 58 provides for the delegation of environmental review to a local responsible entity (City of Lakeland) applicable to this proposed action and establishes NEPA procedural requirements. As part of the NEPA process, the public will be provided an opportunity to review and comment on those evaluations. Two major purposes of the environmental review process are better-informed decisions and stakeholder involvement. AECOM will coordinate with the city to confirm roles and responsibilities.

24 CFR 58.5 provides a listing of Related Federal laws and authorities to be considered in the environmental review, including those related to the evaluation/assessment of potential impacts on social and cultural resources, as well as physical and natural resources. The NEPA process will document compliance with other environmental review requirements, such as the ESA, the National Historic Preservation Act, the Environmental Justice Executive Order (EO 12898), and other Federal, State, and local laws and regulations. Documentation of any tribal coordination and associated comments received would also be included in the NEPA document.

Under NEPA, federal agencies are required to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions affecting the environment. A Class of Action (COA) determination undertaken by the Responsible Entity establishes the level of environmental documentation required for the Proposed Action under NEPA. A federal action may be "categorically excluded" from a detailed environmental analysis as long as it does not individually or cumulatively have a significant effect on the quality of the environment and does not meet extraordinary circumstances. (see 24 CFR 58.2(a)(3)). Compliance with the other applicable Federal environmental laws and authorities is still required.

Specific actions for which HUD requires no environmental impact statement or environmental assessment are listed in 24 CFR 58.35. Depending on the selected alternative and final engineering design plans, it is possible that this project may qualify as a CE based on the following criteria:

24 CFR 58.35(a)(1)

> *(1) Acquisition, repair, improvement, reconstruction, or rehabilitation of public facilities and improvements (other than buildings) when the facilities and improvements are in place and will be retained in the same use without change in size or capacity of more than 20 percent (e.g., replacement of water or sewer lines, reconstruction of curbs and sidewalks, repaving of streets).*

HUD provides a suggested format for documenting CE determinations in its "Part 58 Environmental Review - Exempt or Categorically Excluded (Not Subject to 58.5) Format." This document includes checklists and guidance for evaluating potential environmental impacts and compliance with other laws. The Responsible Entity will complete and certify the above-mentioned form and checklists to show environmental considerations were factored into the project planning and implementation processes.

6.1.5 Federal Emergency Management Agency (FEMA) Compliance

The proposed alternatives developed as part of the Lake Bonnet Drainage Basin Flood Hazard Mitigation Project will require construction within FEMA floodplain and floodway boundaries. **Figure 4 Project Area, FEMA Flood Hazard Map,** illustrates and identifies the Currently Effective Floodplain and Floodway boundaries for the areas directly affected by the proposed alternatives. **Figures 10, 12, 13,** and **15** illustrate and identify the location and extent of the proposed features for Alternatives 1 through 4, respectively.

Implementation of any of the alternatives will require acquisition of a permit through FEMA to document potential changes to effective floodplain boundaries and to demonstrate no adverse impacts to the designated floodway. This will include all onsite and offsite areas with designated boundaries. Offsite effective boundaries extend downstream to Chestnut Road. It is most likely that a Letter of Map Revision (LOMR) application will need to be filed with FEMA. Technical documentation based on the results of hydraulic model studies will be submitted with the LOMR application to demonstrate compliance with FEMA requirements.

Compliance with FEMA regulations regarding floodplain boundaries requires the demonstration of no adverse impacts. The goal of the project is to mitigate the risk of flooding in the project area. All the proposed alternatives attempt to accomplish this goal by lowering flood elevations, thus minimizing floodplain boundaries. It is understood that all the proposed alternatives comply equally with FEMA's regulations.

Compliance with FEMA regulations regarding floodway boundaries requires the demonstration of no adverse impacts, typically achieved by allowing no encroachment into the designated floodway. Within the Project Reach, the floodway boundaries are aligned with the Lake Bonnet Drain channel top of bank. Again, the goal of the Project is to mitigate risk of flooding in the Project Area by lowering flood elevations and minimizing floodplain boundaries. As a result, even though the proposed work (i.e., channel improvement, berms, and/or floodwalls) will occur within the floodway, the future floodway will be established within the banks of the proposed project. It is understood that the proposed alternatives comply equally with FEMA's regulations.

Given that the proposed alternatives are permittable and are essentially equal with respect to FEMA regulatory requirements, no further assessments are required at this time. Detailed modeling will be conducted in support of FEMA approval for the selected alternative. Note that the Effective model was acquired from FEMA to develop a Duplicate Effective model. The model data provided (paper printout) included an echo of USGS Computer Program E431 Version 78.068 Date 1/18/79. This model is no longer available. To reestablish the Effective model, a HEC-RAS model is under development and is being built with the latest data as documented in this report. This model will then be used as a basis for the analysis of the potential impacts of the selected alternative as part of the FEMA permitting process.

6.1.6 Property/ Right-Of-Way (ROW) Requirements

The Lake Bonnet Drain along the Project Reach consists of private properties owned by separate entities. Therefore, permission from all private properties affected is required to perform the flood mitigation project for the alternatives described in this report. Temporary easements will be required for construction access and staging, and permanent easements will be required for access, maintenance and operation. The easements on the properties will be dedicated to the City of Lakeland.

The permanent easements will allow the City of Lakeland to perform routine inspection and maintenance of the Lake Bonnet Drain and pumping facilities installed for the project. Long-term maintenance to be performed by the City of Lakeland would include removing debris and sediment from within the Lake Bonnet Drain, repairing berm and floodwall, and maintaining the pump facilities such as exercising the generators and pumps.

Allowances for temporary and permanent easements have been included for the alternatives in the EOPC (**Appendix D**), which are $600,000 and $100,000, respectively, with a 50% contingency.

6.1.7 Constructability

The Project Reach along the Lake Bonnet Drain is fully developed with existing structures such as homes, streets, and utilities in proximity of the channel, which creates an inconvenience for construction activities.

Construction staging and access, and the sequence of construction will have to be vetted during the design phase while simultaneously reaching out to the affected property owners to secure written consent to allow construction activities on their property. The success of the project will depend on the cooperation of the private properties. In addition to construction accessibility, proper selection of the construction method and equipment is important to prevent damaging nearby existing structures. Prior to breaking ground, the awarded contractor for construction will have to work closely with the City and the design team to develop an executable plan of means and methods with consideration of the affected properties.

The project would require additional security personnel and security equipment, such as fences, cameras, and lighting around the construction site for public safety. Also, maintenance of traffic control personnel and equipment is required during the replacement of the bridge/culvert crossings. These activities increase the construction cost.

All the alternatives require dredging and regrading of the Lake Bonnet Drain to improve flow conveyance. The channel will have to be dewatered first prior to any dredging activity. Dewatering the channel could be accomplished by closing the sluice gates outlet control structure for Lake Bonnet. Temporary sump pumps will be deployed in low areas within the channel, if necessary, to further dry out the area for dredging activity.

If closing the sluice gates outlet control structure for Lake Bonnet is not possible, the other option for dewatering would involve the installation of a temporary cofferdam and a by-pass pump to divert water away from the construction area. Depending on the sequence of construction and access, the dewatering activity may be performed in smaller sections along the channel, whereby the dewatering equipment will have to be relocated as needed throughout construction.

The timing of construction is also critical to the success of the project. The construction should be scheduled to coincide with the dry season. Therefore, procuring the construction contractor in advance of the construction schedule is necessary to ensure the contractor has adequate time to get ready to initiate construction at the beginning of the dry season.

The proposed sump pumps and pump station are located in the flood zone. The critical equipment, such as the generator, fuel tank, and pump controls for the pumps, will have to be raised to prevent damage from flood water. Access to the pumping facilities will have to be raised to allow the City of Lakeland personnel to access the pumping facilities during a flooding event. Providing access could be a challenge with the proximity of the existing structures.

7. Detailed Assessment for each Alternatives

7.1 Alternative 1 – Channel Improvement (Berms/Floodwalls)

As detailed in **Section 5.1**, this channel improvement alternative was designed to provide flood protection in the May Manor and Sterling Park areas by increasing the conveyance capacity of the Lake Bonnet Drain channel and consequently decreasing or eliminating flooded areas within the communities for a range of storm events. As illustrated in **Figure 10 Alternative 1 - Channel Improvement (Berms/Floodwalls)**, this alternative includes the construction of berms and limited floodwalls that are raised above the existing top of bank elevation of the channel and will require eight sump pump stations to convey stormwater runoff from the local drainage system to the channel.

7.1.1 Level of Service (LOS) Performance

The LOS for each alternative was determined from the results of hydrologic modeling studies (described in **Section 3**). Estimated flood stages for each of the modeled flood frequencies were used to develop floodplain boundary maps and summary tables discussed in this section.

7.1.1.1 2.33-Year (Mean Annual) Assessment

Illustrated on **Figure 17 Alternative 1 – Mean Annual (2.33-year) Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 1 conditions. Proposed condition floodplain boundaries are completely contained within the channel’s proposed berm and floodwall system except for two minor peripheral areas. It is important to note that the proposed sump pump stations are required to ensure the residential areas receive this flood reduction, as the elevated berm and floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. Existing top of bank elevation for cross-sections within the Project Reach and required berm and floodwall elevations are provided in **Table 7-1** for comparison.

Referring to **Table 7-1**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below the proposed berm and floodwall system’s top elevation. The Flood Depth column illustrates the distance in feet between the proposed berm and floodwall system’s top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is greater than 1 ft of freeboard in the system for this flood frequency event. In conclusion, Alternative 1 meets the 2.33-year (mean annual) LOS.

Table 7-1 Alternative 1 Comparison 2.33-Year Peak Stage versus Top of Berm Elevation

		2.33-YR EXISTING CONDITION		2.33-YR ALTERNATIVE 1 CONDITION		
Cross-Section	Node[(a)]	TOB Elevation Min[(b)] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Berm and Floodwall TOB Elevation[(d)] (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth[(e)] (ft)
RC0230	Brunnell DS/MayManorHead	141.76	141.50	143.00	141.78	-1.22
RC0275E_UP	MayManorHead	141.22	141.49	143.00	141.77	-1.23
RC0275E_DW	MayManorEast_2	141.24	141.48	143.00	141.77	-1.23
RC0275W_UP	MayManorEast_2	141.08	141.48	143.00	141.77	-1.23
RC0275W_DW	MayManorEast	142.61	141.48	143.00	141.77	-1.23
RC0281E_UP	MayManorWest	142.01	141.47	143.00	141.76	-1.24
RC0281E_DW	SterlingCanal_East (Lt 139.06, Rt 142.61)	142.61	141.47	143.00	141.76	-1.24
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56, Rt 142.31)	142.31	141.47	143.00	141.76	-1.24
RC0320_UP	SterlingCanal	142.23	141.47	143.00	141.76	-1.24
RC0320_DW[(c)]	BridgeBlvdUS	141.78	141.46	143.00	141.75	-1.25
RC0326_UP[(c)]	BridgeBlvdDS	141.18	141.38	143.00	141.64	-1.36
RC0387_DW	WabashUS	146.90	141.21	143.00	141.59	-1.41

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed berms and floodwall.
(e) Depth of flooding measured from proposed berms and floodwalls.

The implementation of Alternative 1 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 2.33-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.1.1.2 10-Year Assessment

Illustrated on **Figure 18 Alternative 1 - 10-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 1 conditions. Proposed condition floodplain boundaries are completely contained within the channel's proposed berm and floodwall system except for one minor peripheral area. It is important to note that the proposed sump pump stations are required to ensure the residential areas receive this flood reduction, as the elevated berm and floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. Existing top of bank elevation for cross-sections within the Project Reach and required berm and floodwall elevations are provided in **Table 7-2** for comparison.

Referring to **Table 7-2**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below the proposed berm and floodwall system's top elevation. The Flood Depth column illustrates the distance in feet between the proposed berm and floodwall system's top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is about 0.5 ft of freeboard in the system for this flood frequency event. In conclusion, Alternative 1 meets the 10-year LOS.

Table 7-2 Alternative 1 Comparison 10-Year Peak Stage versus Minimum Top of Berm Elevation

		10-YR EXISTING CONDITION		10-YR ALTERNATIVE 1 CONDITION		
Cross-Section	**Node[a]**	**TOB Elevation Min[b] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Berm and Floodwall TOB Elevation[d] (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[e] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	142.23	143.00	142.53	-0.47
RC0275E_UP	MayManorHead	141.22	142.22	143.00	142.53	-0.47
RC0275E_DW	MayManorEast_2	141.24	142.20	143.00	142.53	-0.47
RC0275W_UP	MayManorEast_2	141.08	142.20	143.00	142.53	-0.47
RC0275W_DW	MayManorEast	142.61	142.20	143.00	142.52	-0.48
RC0281E_UP	MayManorWest	142.01	142.19	143.00	142.52	-0.48
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.19	143.00	142.52	-0.48
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	142.19	143.00	142.52	-0.48
RC0320_UP	SterlingCanal	142.23	142.19	143.00	142.52	-0.48
RC0320_DW[c]	BridgeBlvdUS	141.78	142.18	143.00	142.51	-0.49
RC0326_UP[c]	BridgeBlvdDS	141.18	142.10	143.00	142.47	-0.53
RC0387_DW	WabashUS	146.90	141.83	143.00	142.40	-0.60

(a) Model node, results used to determine existing and proposed flood elevations.

(b) Existing top-of-bank elevation at cross-section location.

(c) Cross-section for proposed condition only.

(d) Elevation of the top of the proposed berms and floodwall.

(e) Depth of flooding measured from proposed berms and floodwalls.

The implementation of Alternative 1 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 10-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.1.1.3 25-Year Assessment

Illustrated on **Figure 19 Alternative 1 – 25-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 1 conditions. Proposed condition floodplain boundaries are completely contained within the channel's proposed berm and floodwall system except for one minor peripheral area. It is important to note that the proposed sump pump stations are required to ensure the residential areas receive this flood reduction, as the elevated berm and floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. The existing top of bank elevation for cross-sections within the Project Reach and the required berm and floodwall elevations are provided in **Table 7-3** for comparison.

Referring to **Table 7-3**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below proposed berm and floodwall system's top elevation. The Flood Depth column illustrates the distance in feet between the proposed berm and floodwall system's top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is a 0.16-ft minimum of freeboard in the system for this flood frequency event. In conclusion, for Alternative 1, the floods are contained within the channel and meet the 25-year LOS. However, due to the very small amount of freeboard it barely meets the 25-year LOS.

Table 7-3 Alternative 1 Comparison 25-Year Peak Stage versus Minimum Top of Berm Elevation

		25-YR EXISTING CONDITION		25-YR ALTERNATIVE 1 CONDITION		
Cross-Section	**Node[a]**	**TOB Elevation Min[b] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Berm and Floodwall TOB Elevation[d] (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[e] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	142.65	143.00	142.84	-0.16
RC0275E_UP	MayManorHead	141.22	142.64	143.00	142.84	-0.16
RC0275E_DW	MayManorEast_2	141.24	142.61	143.00	142.83	-0.17
RC0275W_UP	MayManorEast_2	141.08	142.61	143.00	142.83	-0.17
RC0275W_DW	MayManorEast	142.61	142.61	143.00	142.83	-0.17
RC0281E_UP	MayManorWest	142.01	142.60	143.00	142.82	-0.18
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.60	143.00	142.82	-0.18
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	142.60	143.00	142.82	-0.18
RC0320_UP	SterlingCanal	142.23	142.59	143.00	142.82	-0.18
RC0320_DW[c]	BridgeBlvdUS	141.78	142.59	143.00	142.81	-0.19
RC0326_UP[c]	BridgeBlvdDS	141.18	142.54	143.00	142.77	-0.23
RC0387_DW	WabashUS	146.90	142.20	143.00	142.69	-0.31

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed berms and floodwall.
(e) Depth of flooding measured from proposed berms and floodwalls.

The implementation of Alternative 1 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 25-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.1.1.4 100-Year Assessment

Illustrated on **Figure 20 Alternative 1 – 100-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 1 conditions. Proposed condition floodplain boundaries are approximately equivalent to existing conditions' boundaries. This is due to the conveyance limit of the improved channel being exceeded by the volume of discharge and associated pumping rates. Floodplain elevations within the entire Lake Bonnet Drain system are partly to blame for this condition, as downstream stages cause a backup in the Project Reach.

Referring to **Table 7-4**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. Additionally, the Flood Depth column illustrates the distance in feet between the proposed berm and floodwall system's top elevation and the proposed flood elevation. The positive values highlighted in red indicate that the proposed flood elevations within the channel exceed the proposed berm and floodwall system's top elevation. Note the LOS in the Project Reach cannot be improved beyond the 25-year level, as this would require increasing the berm and floodwall system's top elevation. This action would act to decrease the system's conveyance due to channel geometry limitations. In conclusion, Alternative 1 does not meet the 100-year LOS.

Table 7-4 Alternative 1 Comparison 100-Year Peak Stage versus Minimum Top of Berm Elevation

		100-YR EXISTING CONDITION		100-YR ALTERNATIVE 1 CONDITION		
Cross-Section	Node[a]	TOB Elevation Min[b] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Berm and Floodwall TOB Elevation[d] (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth[e] (ft)
RC0230	Brunnell DS/MayManorHead	141.76	143.54	143.00	143.55	0.55
RC0275E_UP	MayManorHead	141.22	143.52	143.00	143.54	0.54
RC0275E_DW	MayManorEast_2	141.24	143.49	143.00	143.51	0.51
RC0275W_UP	MayManorEast_2	141.08	143.49	143.00	143.51	0.51
RC0275W_DW	MayManorEast	142.61	143.48	143.00	143.51	0.51
RC0281E_UP	MayManorWest	142.01	143.47	143.00	143.50	0.50
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	143.47	143.00	143.50	0.50
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	143.47	143.00	143.50	0.50
RC0320_UP	SterlingCanal	142.23	143.47	143.00	143.49	0.49
RC0320_DW[c]	BridgeBlvdUS	141.78	143.46	143.00	143.47	0.47
RC0326_UP[c]	BridgeBlvdDS	141.18	143.44	143.00	143.45	0.45
RC0387_DW	WabashUS	146.90	142.98	143.00	143.33	0.33

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed berms and floodwall.
(e) Depth of flooding measured from proposed berms and floodwalls.

The implementation of Alternative 1 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 100-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.1.1.5 Alternative 1 Assessment Summary

Implementation of Alternative 1 proposed floodplain mitigation improvements provide a LOS up to and including the 25-year event. It is important to note that the assessment does not consider the 1-foot freeboard as a safety factor. The 100-year LOS was not attained. **Table 7-5** presents a comparison of the number of structures affected (within the floodplain boundary) under existing conditions versus the number of structures affected under proposed conditions within the project area. A comparison is provided for each flood event ranging from the 2.33-year (mean annual) through the 100-year event.

Table 7-5 Alternative 1 Affected Structures within Project Area Summary

	Flood Frequency			
Affected Structures	100-year	25-year	10-year	2.33-year
Existing	220	154	108	43
Proposed	220	1	1	1
% Improvement	0%	99%	99%	98%

Note: Structures include mobile homes and park facilities.

7.1.2 Offsite Impacts (Flood Levels and Flows)

The flood elevation and flow rate information presented in this section is important to the assessment of potential structural (buildings, roads, bridges, utilities, etc.) as well as environmental impacts. The type of features impacted and the magnitude of the impacts are critical to Stormwater, Environmental, Floodplain Management, and other permits that will be required for this Project. Impact information is presented individually for each of the four flood frequency events considered as part of the Project.

Implementation of Alternative 1 proposed floodplain mitigation improvements within the project area results in offsite impacts in the reach of Lake Bonnet Drain downstream of North Wabash Avenue. These impacts include changes in flood elevation and flood flow rates. **Appendix C** contains a model results summary comparison of existing condition versus proposed alternative condition 'Max Stage' (flood elevation) and 'Max Total Inflow Rate' (flood flow rate). The summary table has been formatted to highlight (red) nodes that experience an increase in flood elevation and highlight (green) nodes that experience an increase in flood flow rate.

Figures 21 through 24 illustrate the disposition of each node (entire model domain) with respect to changes in flood elevation and flow rate. Specifically, Red symbols indicate locations (nodes) that increase both in flood elevation and flood flow rate, Orange symbols indicate locations that increase in flood elevation only, Blue symbols indicate locations that increase in flood flow rate only, and for reference only, Green symbols indicate locations with no flood elevation or flood flow rate increase.

Selected node locations (directly adjacent to the Lake Bonnet Drain channel), as shown in the figures, have been identified by name to correlate with the nodes in the tables identified in **Appendix C**. The tables provide the summary results of the entire model network stages and flows.

Table 7-6 provides a summary of the number of model locations (west of N. Wabash Ave.) where flood elevation and flow rate change relative to existing conditions resulting from the implementation of Alternative 1.

Table 7-6 Offsite Impacts Alternative 1 - Change in Model Flood Elevation and Flow Rate (1)

Event Frequency	Stg +, Flow +	Stg +, Flow 0	Stg 0, Flow +	Stg 0, Flow 0
100-year	17	3	17	51
25-year	16	2	17	53
10-year	17	0	21	50
2.33-year	17	1	19	51

Notes: Indicates the number of model locations where flood elevation and flow rate change relative to existing conditions for areas wet of N. Wabash Ave.

7.1.3 Engineer's Opinion of Probable Cost (EOPC)

The construction cost for Alternative 1 is $16.8M. However, the long-term operation and maintenance should be considered. There are eight sump pump stations, and the storm drainage system that will convey stormwater to the sump pumps will require maintenance. There will be routine maintenance such as removing debris and sediment within Lake Bonnet Drain, repairing berm and floodwall, and maintaining the pump facilities such as exercising the generators and pumps and maintaining the access path leading to the sump pumps. Also, a nearby location will have to be identified to store spare parts for the sump pumps.

The City of Lakeland will require in-house staff or outside consultants with technical expertise to diagnose, repair, operate, and maintain the sump pumps.

The sump pumps are an added expense and should be factored into the City's budget prior to selecting the alternative.

7.1.4 Permit Issues, Mitigation Requirements, and Feasibility

Alternative 1 proposes improvements that are focused on the Lake Bonnet Drain channel. W12 and W13 may be impacted by each of these alternatives. One additional wetland, W14, occurs near the channel but is located sufficiently far enough from the channel not to be impacted by Alternative 1.

Alternative 1 proposes a barrier, either berm or floodwall, at the boundary of the channel and adjacent habitat. Currently, W13 is separated from the channel by a berm. W12 was created as a floodplain compensation area. The floodplain compensation area has developed into forested wetland habitat over time. A small channel hydrologically connects W13 to the channel during periods of high water levels.

For the feasibility study, 0.5-1.0 acre of direct wetland impacts have been assumed as a result of Alternative 1 to each wetland (W12 and W13). During the design phase, the quantity of direct and indirect wetland impacts will be refined and finalized. During the permitting phase, the project will need to demonstrate that wetland impacts have been avoided or minimized to the greatest extent practicable.

The USACE and SWFWMD both assess wetland impacts using the Uniform Mitigation Assessment Method (UMAM) in accordance with Chapter 62-345, F.A.C. The UMAM assesses the function of wetlands by analyzing three categories of indicators of wetland function: Location and Landscape, Water Environment, and Community Structure.

- **Location and Landscape:** Assesses the geographic setting of the wetland in relation to surrounding habitats, including wetlands, surface waters, upland habitat, and man-made development. The ecological relationship of the wetland and surrounding habitat differs as the geographic setting surrounding the wetland changes from undeveloped habitats to developed areas.
- **Water Environment:** Assesses hydrologic conditions of the wetland area. Factors that influence the hydrology of the wetland include the timing, frequency, depth, and duration of inundation or saturation and the quality of water within the wetland. This category also considers water quality inputs from surrounding upstream areas.
- **Community Structure:** Assess the plant assemblages within the wetland area. Characteristics such as the amount of exotic vegetation or the health of the vegetation are assessed.

Table 7-7 details the preliminary range of wetland functional loss assessed for direct impacts to W12 and W13.

Table 7-7 Range of Wetland Functional Loss Assessed for Direct Wetland Impacts for Alternative 1

Assessment Area	Wetland Function			UMAM Delta (Score)	Impact Range (Acre)	Range of Functional Loss
	Location and Landscape	Water Environment	Community Structure			
W12	6 to 7	7 to 8	7 to 8	0.66 to 0.77	0.5 to 1	0.33 to 0.77
W13	6 to 7	7 to 8	7 to 8	0.66 to 0.77	0.5 to 1	0.33 to 0.77

During the design phase, a detailed UMAM analysis will be conducted to determine the functional value of each wetland. During the permitting phase, the permit applications will include a proposal for the value of wetland function for each wetland area impacted, which the regulatory agencies will review. UMAM values may vary for the USACE and SWFWMD due to differing calculation components for mitigation time lag and risk. Indirect or secondary impacts to the remaining portions of each wetland will also be assessed and included in the final mitigation plan during the permitting phase of the project.

Based on the USACE's 2008 compensatory mitigation rule, the purchase of mitigation bank credits should be the first option to address wetland mitigation. Mitigation banks are typically larger tracts of land with wetlands that have been improved, providing higher wetland function. The difference between wetland functional baseline scores and the improvements generates mitigation credits available for purchase to compensate for wetland impacts.

There are several mitigation banks that service the Hillsborough River drainage basin. Currently, freshwater forested credits range from $125,000 to $150,000 per credit. Therefore, mitigation costs for implementing either Alternative 1 or Alternative 2 range from $42,000 to $115,000. The availability of mitigation bank credits is market-driven, and each mitigation bank has a fixed number of credits available for sale. Current mitigation bank credit availability is not indicative of future availability.

The SWFWMD has water quantity and water quality requirements as part of the ERP. Water quantity requirements include demonstrating the proposed improvements will not increase flood stages on offsite lands upstream or downstream of the project area for the 2.33 year – 24-hour, 10 year – 24-hour, 25 year – 24 hour and 100-year – 24-hour storm events. Alternative 1 adds berms and floodwalls on both sides of the Lake Bonnet Drain channel with top elevations above the existing grade for the adjacent properties. The eight (8) sump pumps on both sides of the channel adjacent to the berms and floodwalls are designed to convey water into the channel to prevent flooding. The proposed improvements to the Lake Bonnet Drain channel increase the conveyance capacity. Therefore, increasing water stages and flows in the channel downstream of the project area is expected. The ICPR (StormWise) model results indicate water stages have increased. The increased stages are within the channel and in areas outside the channel. The SWFWMD will most likely comment on the permit application that the design needs to be revised to lower water stages to be equivalent to or less than existing condition stages for the four storm events at downstream areas. The SWFWMD will probably accept the increased water stages within channels because they are established drainage easements maintained by the City of Lakeland, and the peak water surface elevations in the channels are below the top of bank elevations of the channel. However, the increased water stages outside the channel could be problematic. Additional information in the permit application will have to be included to demonstrate the increased stages do not adversely impact the off-site properties. The demonstration could include that no critical infrastructure, such as roadways, driveways, buildings, etc., are flooded, and the increased water stages are in areas where there is no development and are in a low area such as a wetland, lake, pond, etc.

Peak flows downstream of the project did increase with the implementation of Alternative 1. However, Alternative 1 does not add impervious areas that increase stormwater runoff volumes. Therefore, the proposed condition peak discharge rate is not required to be less than the existing condition peak discharge rate for the 25-year -24-hour storm event. Therefore, it is not expected that the increased flows will impede issuance of a permit from the SWFWMD.

Another water quantity requirement is demonstrating no loss or storage in the 100 year – 24-hour floodplain established by FEMA. The project involves work within the 100-year -24-hour floodplain. Alternative 1 involves widening the Lake Bonnet Drain channel to increase the flow capacity. Therefore, loss of storage in the FEMA floodplain does not occur. Calculations demonstrating no loss of floodplain storage from the seasonal high-water elevation to the peak water stage for the 100-year -24-hour storm event is required.

Alternative 1 does not add impervious areas. Therefore, adding permanent Best Management Practices (BMPs) designed under the presumptive criteria to treat stormwater runoff is not required. The Lake Bonnet Drain ultimately drains to the Itchepackesassa Creek, which is identified by the Florida Department of Environmental Protection (FDEP) as Water Body Identifications (WBIDs) 1495A and 1543A2, which are listed as impaired. The SWFWMD requires a demonstration of a net environmental improvement or no increase in annual loads of nitrogen and phosphorus to Itchepackesessa Creek. Calculations demonstrating that annual loads of nitrogen and phosphorus are not increased will be performed to demonstrate compliance with the nutrient load criteria for the Itchepackesassa Creek WBIDs.

7.1.5 FEMA Compliance

Refer to **Section 6.2.5**.

7.1.6 Property/ Right-Of-Way (ROW) Requirements

Construction activity for Alternative 1 is limited to Sterling Homes and May Manor properties. The City of Lakeland will need to obtain consent and permission from Sterling Homes and May Manor to perform the work under this alternative. Temporary construction easements and permanent easements for access and maintenance are required for the alternative. Refer to **Section 6.2.6** for additional details.

7.1.7 Constructability

Refer to **Section 6.1.7**.

7.2 Alternative 2 – Channel Improvement (Floodwalls)

As detailed in **Section 5.2**, this channel improvement alternative was designed to provide flood protection in the May Manor and Sterling Park areas by increasing the conveyance capacity of the Lake Bonnet Drain channel and consequently decreasing or eliminating flooded areas within the communities for a range of storm events. As illustrated in **Figure 12 Alternative 2 - Channel Improvement (Floodwalls)**, this alternative includes the construction of floodwalls that are raised above the existing top of the bank elevation of the channel. The revised channel cross-sectional configuration (vertical side slopes due to floodwall) will act to maximize the conveyance capacity within the Project Reach. Eight sump pump stations are also required to convey stormwater runoff from the local drainage system to the channel.

7.2.1 Performance/ Level of Service (LOS)/ Effectiveness at Mitigation

The LOS for each alternative was determined from the results of hydrologic modeling studies (described in **Section 4**). Estimated flood stages for each of the modeled flood frequencies were used to develop floodplain boundary maps and summary tables discussed in this section.

7.2.1.1 2.33-Year (Mean Annual) Assessment

Illustrated on **Figure 21 Alternative 2 - Mean Annual (2.33-Year) Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 2 conditions. Proposed condition floodplain boundaries are completely contained within the channel's proposed floodwall system except for two minor peripheral areas. It is important to note that the proposed sump pump stations are required to ensure the residential areas receive this flood reduction, as the elevated floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. Existing top of bank elevation for cross-sections within the Project Reach and required floodwall elevations are provided in **Table 7-8** for comparison.

Referring to **Table 7-8**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below the proposed floodwall system's top elevation. The Flood Depth column illustrates the distance in feet between the proposed floodwall system's top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is greater than 1-ft of freeboard in the system for this flood frequency event. In conclusion, Alternative 2 meets the 2.33-year (mean annual) LOS.

Table 7-8 Alternative 2 Comparison 2.33-Year Peak Stage vs Top of Floodwall Elevation

		2.33-YR EXISTING CONDITION		**2.33-YR ALTERNATIVE 2 CONDITION**		
Cross-Section	**Node[a]**	**TOB Elevation Min[b] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Floodwall TOB Elevation[d] (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[e] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	141.50	143.00	141.66	-1.35
RC0275E_UP	MayManorHead	141.22	141.49	143.00	141.65	-1.35
RC0275E_DW	MayManorEast_2	141.24	141.48	143.00	141.65	-1.35
RC0275W_UP	MayManorEast_2	141.08	141.48	143.00	141.65	-1.35
RC0275W_DW	MayManorEast	142.61	141.48	143.00	141.65	-1.35
RC0281E_UP	MayManorWest	142.01	141.47	143.00	141.64	-1.36
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	141.47	143.00	141.64	-1.36
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	141.47	143.00	141.64	-1.36
RC0320_UP	SterlingCanal	142.23	141.47	143.00	141.64	-1.36
RC0320_DW[c]	BridgeBlvdUS	141.78	141.46	143.00	141.64	-1.36
RC0326_UP[c]	BridgeBlvdDS	141.18	141.38	143.00	141.53	-1.47
RC0387_DW	WabashUS	146.90	141.21	143.00	141.48	-1.52

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed floodwalls.
(e) Depth of flooding measured from proposed floodwalls.

The implementation of Alternative 2 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 2.33-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.2.1.2 10-Year Assessment

Illustrated on **Figure 22 Alternative 2 – 10-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 2 conditions. Proposed condition floodplain boundaries are completely contained within the channel's proposed floodwall system except for one minor peripheral area. It is important to note that the proposed sump pump stations are required to ensure the residential areas receive this flood reduction, as the elevated floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. Existing top of bank elevation for cross-sections within the Project Reach and required floodwall elevations are provided in **Table 7-9** for comparison.

Referring to **Table 7-9**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below the proposed floodwall system's top elevation. The Flood Depth column illustrates the distance in feet between the proposed floodwall system's top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is about 0.5-ft of freeboard in the system for this flood frequency event. In conclusion, Alternative 2 meets the 10-year LOS.

Table 7-9 Alternative 2 Comparison 10-Year Peak Stage vs Minimum Top of Floodwall Elevation

		10-YR EXISTING CONDITION		10-YR ALTERNATIVE 2 CONDITION		
Cross-Section	**Node[(a)]**	**TOB Elevation Min[(b)] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Floodwall TOB Elevation[(d)] (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[(e)] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	142.23	143.00	142.41	-0.59
RC0275E_UP	MayManorHead	141.22	142.22	143.00	142.41	-0.59
RC0275E_DW	MayManorEast_2	141.24	142.20	143.00	142.40	-0.60
RC0275W_UP	MayManorEast_2	141.08	142.20	143.00	142.40	-0.60
RC0275W_DW	MayManorEast	142.61	142.20	143.00	142.40	-0.60
RC0281E_UP	MayManorWest	142.01	142.19	143.00	142.40	-0.60
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.19	143.00	142.39	-0.61
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	142.19	143.00	142.39	-0.61
RC0320_UP	SterlingCanal	142.23	142.19	143.00	142.39	-0.61
RC0320_DW[(c)]	BridgeBlvdUS	141.78	142.18	143.00	142.39	-0.61
RC0326_UP[(c)]	BridgeBlvdDS	141.18	142.10	143.00	142.34	-0.66
RC0387_DW	WabashUS	146.90	141.83	143.00	142.27	-0.73

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed floodwalls.
(e) Depth of flooding measured from proposed floodwalls.

The implementation of Alternative 2 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 10-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.2.1.3 25-Year Assessment

Illustrated on **Figure 23 Alternative 2 – 25-Year Event Floodplain Map** are floodplain boundaries for existing and proposed alternative 2 conditions. Proposed condition floodplain boundaries are completely contained within the channel's proposed floodwall system except for one (1) minor peripheral area. It is important to note that the proposed sump-pump stations are required to ensure the residential areas receive this flood reduction, as the elevated floodwall system (143 ft-NAVD top elevation), which is required to provide adequate channel conveyance, also acts to prevent free surface drainage to the channel. Existing top of bank elevation for cross-sections within the Project Reach and required floodwall elevations are provided in **Table 7-10** for comparison.

Referring to **Table 7-10**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. This is of no consequence as the proposed condition flood elevations are all below the proposed floodwall system's top elevation. The Flood Depth column illustrates the distance in feet between the proposed floodwall system's top elevation and the proposed flood elevation. The negative values highlighted in green indicate that there is about 0.25-ft of freeboard in the system for this flood frequency event. In conclusion, Alternative 2 meets the 25-year LOS.

Table 7-10 Alternative 2 Comparison 25-Year Peak Stage vs Minimum Top of Floodwall Elevation

Cross-Section	Node(a)	25-YR EXISTING CONDITION		25-YR ALTERNATIVE 2 CONDITION		
		TOB Elevation Min(b) (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Floodwall TOB Elevation(d) (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth(e) (ft)
RC0230	Brunnell DS/MayManorHead	141.76	142.65	143.00	142.76	-0.24
RC0275E_UP	MayManorHead	141.22	142.64	143.00	142.76	-0.24
RC0275E_DW	MayManorEast_2	141.24	142.61	143.00	142.75	-0.25
RC0275W_UP	MayManorEast_2	141.08	142.61	143.00	142.75	-0.25
RC0275W_DW	MayManorEast	142.61	142.61	143.00	142.75	-0.25
RC0281E_UP	MayManorWest	142.01	142.60	143.00	142.74	-0.26
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.60	143.00	142.74	-0.26
RC0281W	SterlingCanal_East/Sterling Canal (Lt 139.56,Rt 142.31)	142.31	142.60	143.00	142.74	-0.26
RC0320_UP	SterlingCanal	142.23	142.59	143.00	142.74	-0.26
RC0320_DW(c)	BridgeBlvdUS	141.78	142.59	143.00	142.73	-0.27
RC0326_UP(c)	BridgeBlvdDS	141.18	142.54	143.00	142.70	-0.30
RC0387_DW	WabashUS	146.90	142.20	143.00	142.61	-0.39

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-bank elevation at cross-section location.
(c) Cross-section for proposed condition only.
(d) Elevation of the top of the proposed floodwalls.
(e) Depth of flooding measured from proposed floodwalls.

The implementation of Alternative 2 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 25-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.2.1.4 100-Year Assessment

Illustrated on **Figure 24 Alternative 2 – 100-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 2 conditions. Proposed condition floodplain boundaries are approximately equivalent to existing conditions boundaries. This is due to the conveyance limit of the improved channel being exceeded by the volume of discharge and associated pumping rates. Floodplain elevations within the entire Lake Bonnet Drain system are partly to blame for this condition, as downstream stages cause a backup in the Project Reach.

Referring to **Table 7-11**, the proposed condition flood elevations at each cross-section within the Project Reach are greater than the existing condition flood elevations. Additionally, the Flood Depth column illustrates the distance in feet between the proposed floodwall system's top elevation and the proposed flood elevation. The positive values highlighted in red indicate that the proposed flood elevations within the channel exceed the floodwall system's top elevation. Note that the LOS in the Project Reach could be increased to the 100-year level, which would require increasing the floodwall system's top elevation. This action would increase the system's conveyance but would have negative consequences related to cost and community aesthetics. In conclusion, Alternative 2 does not meet the 100-year LOS.

Table 7-11 Alternative 2 Comparison 100-Year Peak Stage vs Minimum Top of Floodwall Elevation

		100-YR EXISTING CONDITION		100-YR ALTERNATIVE 2 CONDITION		
Cross-Section	Node[a]	TOB Elevation Min[b] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Floodwall TOB Elevation[d] (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth[e] (ft)
RC0230	Brunnell DS/MayManorHead	141.76	143.54	143.00	143.48	0.48
RC0275E_UP	MayManorHead	141.22	143.52	143.00	143.47	0.47
RC0275E_DW	MayManorEast_2	141.24	143.49	143.00	143.45	0.45
RC0275W_UP	MayManorEast_2	141.08	143.49	143.00	143.45	0.45
RC0275W_DW	MayManorEast	142.61	143.48	143.00	143.44	0.44
RC0281E_UP	MayManorWest	142.01	143.47	143.00	143.44	0.44
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	143.47	143.00	143.43	0.43
RC0281W	SterlingCanal_East/Sterling Canal (Lt 139.56,Rt 142.31)	142.31	143.47	143.00	143.43	0.43
RC0320_UP	SterlingCanal	142.23	143.47	143.00	143.43	0.43
RC0320_DW(c)	BridgeBlvdUS	141.78	143.46	143.00	143.42	0.42
RC0326_UP(c)	BridgeBlvdDS	141.18	143.44	143.00	143.40	0.40
RC0387_DW	WabashUS	146.90	142.98	143.00	143.27	0.27

(a) Model node, results used to determine existing and proposed flood elevations.

(b) Existing top-of-bank elevation at cross-section location.

(c) Cross-section for proposed condition only.

(d) Elevation of the top of the proposed floodwalls.

(e) Depth of flooding measured from proposed floodwalls.

The implementation of Alternative 2 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 100-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.2.1.5 Alternative 2 Assessment Summary

Implementation of Alternative 2 proposed floodplain mitigation improvements provide a LOS up to and including the 25-year event. It is important to note the assessment does not consider the 1-foot of freeboard as a factor of safety. The 100-year LOS was not attained. **Table 7-12** presents a comparison of the number of structures affected (within floodplain boundary) under existing conditions versus the number of structures affected under proposed conditions within the project area. A comparison is provided for each flood event ranging from the 2.33-year (mean annual) through the 100-year event.

Table 7-12 Alternative 2 Affected Structures within Project Area Summary

	Flood Frequency			
Affected Structures	100-year	25-year	10-year	2.33-year
Existing	220	154	108	43
Proposed	220	1	1	1
% Improvement	0%	99%	99%	98%

Note: Structures include mobile homes and park facilities.

7.2.2 Offsite Impacts (Flood Levels and Flows)

The flood elevation and flow rate information presented in this section is important to the assessment of potential structural (buildings, roads, bridges, utilities, etc.), and environmental impacts. The type of features impacted and the magnitude of the impacts are critical to Stormwater, Environmental, Floodplain Management, and other permits that will be required for this Project. Impact information is presented individually for each of the four (4) flood frequency events considered as Part of the Project.

Implementation of Alternative 2 proposed floodplain mitigation improvements within the Project Area result in some offsite impacts in the reach of Lake Bonnet Drain downstream of North Wabash Avenue. These impacts include changes in flood elevation and flood flow rates. **Appendix C** contains a model results summary comparison of existing condition versus proposed alternative condition 'Max Stage' (flood elevation) and 'Max Total Inflow Rate' (flood flow rate). The summary table has been formatted to highlight (red) nodes that experience an increase in flood elevation and highlight (green) nodes that experience an increase in flood flow rate.

Figures 29 through 32 illustrate the disposition of each node (entire model domain) with respect to changes in flood elevation and flow rate. Specifically, Red symbols indicate locations (nodes) that increase both in flood elevation and flood flow rate, Orange symbols indicate locations that increase in flood elevation only, Blue symbols indicate locations that increase in flood flow rate only, and for reference only, Green symbols indicate locations with no flood elevation or flood flow rate increase.

Selected node locations (directly adjacent to the Lake Bonnet Drain channel), as shown in the figures, have been identified by name to correlate with the nodes in the tables identified in **Appendix C**. The tables provide the summary results of the entire model network stages and flows.

Table 7-13 provides a summary of the number of model locations (west of N. Wabash Ave.) where flood elevation and flow rate change relative to existing conditions due to the implementation of Alternative 2.

Table 7-13 Offsite Impacts Alternative 2 - Change in Model Flood Elevation and Flow Rate (1)

Event Frequency	Stg +, Flow +	Stg +, Flow 0	Stg 0, Flow +	Stg 0, Flow 0
100-year	16	4	15	53
25-year	16	2	16	54
10-year	17	0	21	50
2.33-year	17	0	18	53

(1) Indicates the number of model locations where flood elevation and flow rate change relative to existing conditions for areas west of N. Wabash Ave.

7.2.3 Engineer's Opinion of Probable Cost (EOPC)

The improvements for Alternatives 1 and 2 are similar except for the type of floodwalls proposed. Alternative 1 proposes a combination of berms and sheet pile, whereas Alternative 2 proposes sheet pile only. The construction cost for Alternative 2 is $20.2M, which came in higher than Alternative 1 by $3.4M.

Similar to Alternative 1, the long-term operation and maintenance should be considered. There are eight sump pump stations, and the storm drainage system that will convey stormwater to the sump pumps will require maintenance.

There will be routine maintenance such as removing debris and sediment within LBD, repairing floodwall, and maintaining the pump facilities such as exercising the generators and pumps and maintaining the access path leading to the sump pumps. Also, a nearby location will have to be identified to store spare parts for the sump pumps.

The City of Lakeland will need in-house staff or outside consultant with technical expertise to diagnose, repair, operate and maintain the sump pumps.

The sump pumps are an added expense and should be factored into the City's budget prior to selecting the alternative.

7.2.4 Permit Issues, Mitigation Requirements, and Feasibility

Both Alternatives 1 and 2 are similar in that the proposed improvements are focused on the LBDC. W12 and W13 may be impacted by each of these alternatives. The full discussion for Alternative 1 is provided in **Section 7.1.4**.

7.2.5 FEMA Compliance

Refer to **Section 6.2.5**.

7.2.6 Property/ Right-Of-Way (ROW) Requirements

Similar to Alternative 1, construction activity for Alternative 2 is limited to Sterling Homes and May Manor properties. The City of Lakeland will need to obtain consent and permission from Sterling Homes and May Manor to perform the work under this alternative. Temporary construction easements and permanent easements for access and maintenance are required for the alternative. Refer to **Section 6.2.6** for additional details.

7.2.7 Constructability

Refer to **Section 6.1.7**.

7.3 Alternative 3 – Backpumping to Lake Bonnet

As detailed in **Section 5.3**, the backpumping to Lake Bonnet alternative was designed to provide flood protection in the May Manor and Sterling Park areas by decreasing stream flows in the Lake Bonnet Drain channel, therefore lowering flood stages below existing levels for a range of storm events. As illustrated in **Figure 13 Alternative 3 - Backpumping to Lake Bonnet**, this alternative includes a pump station, channel improvements within the Project Reach (regrading only from the existing top of bank to support the revised channel profile geometry), a pipe system required to convey pumped stormwater through the North Brunnell Parkway embankment, and a limited number of sump pump stations that will be needed to convey local drainage into the Lake Bonnet Drain channel. Note that channel improvements include a limited number of floodwall sections required at channel transition locations for road crossings and at the Lake Bonnet control structure.

7.3.1 Performance/Level of Service (LOS)/Effectiveness at Mitigation

The LOS for each alternative was determined from the results of hydrologic modeling studies (described in **Section 4**). Estimated flood stages for each of the modeled flood frequencies were used to develop floodplain boundary maps and summary tables discussed in this section.

7.3.1.1 2.33-Year (Mean Annual) Assessment

Illustrated on **Figure 25 Alternative 3 - Mean Annual (2.33-Year) Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 3 conditions. Referring to **Table 7-14**, the ‘Flood Depth’ column indicates that the proposed condition flood elevations at each cross-section are lower than the channel top of bank elevation (negative values highlighted in green), i.e., flood elevations for this event are contained within the Lake Bonnet Drain channel. Additionally, the ‘Depth Reduction’ column indicates the amount of flood elevations that were lowered under the proposed condition, in this case, approximately 0.5 feet on average at each channel location.

Proposed condition floodplain boundaries for areas located east of the May Manor bridge are completely contained within the existing channel banks except for two minor peripheral areas where there are no impacts to structures. These minor flood areas are not caused by the channel overflowing its banks but are due to low-lying areas landward of the channel where the ground elevation is lower than the channel bank elevation; thus, stormwater runoff cannot flow directly to the channel.

The south bank of Lake Bonnet Drain channel between Sterling Canal and May Manor bridge is characteristically lower than the adjacent areas. As well, areas landward of the channel are lower than their surroundings. The Alternative 3 concept specifies channel grading from the top of bank waterward with no construction of berms to raise the channel bank elevations. As illustrated, this area’s proposed condition floodplain boundaries are just slightly less extensive than the existing condition boundaries, even with an estimated 0.55-foot reduction in proposed condition flood levels (see **Table 7-14**, ‘Depth Reduction’ column, Cross-Section RC0281W). Resultant impacts in this area are considered insignificant as no structures (dwellings) are at risk, and the hydrology of the mitigation wetland contained within this area will not be affected.

The north bank of Lake Bonnet Drain channel between Sterling Canal and May Manor bridge is characteristically lower than other areas, however the existing protective berm (levee) has raised the effective top of bank allowing greater flood protection. The minimum elevation of the berm (low spot) is 141.33 ft-NAVD. Areas located landward of the berm are topographically lower than their surroundings. The lowest of these areas is located near Cross-Section RC0281W with ground elevation being about two feet below the minimum top of berm elevation. This area has been referred to as ‘The Bowl.’ As indicated in **Table 7-14**, ‘Flood Depth’ column, the estimated flood elevation is lower than the channel bank at all locations within the Project Reach. As illustrated, this area’s proposed condition floodplain boundaries are less extensive than the existing condition boundaries, attributable to the estimated 0.55-foot reduction in proposed condition flood levels (see **Table 7-14**, ‘Depth Reduction’ column, Cross-Section RC0281W). It is important to note that flooding in this area is not caused by the channel overflowing its banks but is due to low-lying areas landward of the channel where the ground elevation is lower than the channel bank elevation; thus, stormwater runoff cannot flow directly to the channel. As such Alternative 3 includes two sump pump stations that will prevent this area from flooding. This effectively reduces the floodplain boundary to the Lake Bonnet Drain channel limits and eliminates the flood risks to those structures shown on the map figure.

All remaining areas downstream of Sterling Canal experience reduced proposed condition floodplain boundaries due to the reduction of flood elevations as indicated in **Table 7-14**, ‘Depth Reduction’ column.

In conclusion, Alternative 3 meets the 2.33-year (mean annual) LOS. An additional benefit of this alternative is that backpumping to Lake Bonnet will have the effect of decreasing the duration of flooding by about 7 hours for the 2.33-year event.

Table 7-14 Alternative 3 Comparison 2.33-Year Peak Stage vs. Top of Channel Bank Elevation

		2.33-YR EXISTING CONDITION		2.33-YR ALTERNATIVE 3 CONDITION		
Cross-Section	**Node[(a)]**	**TOB Elevation Min[(b)] (ft-NAVD**	**Existing Flood Elevation (ft-NAVD)**	**Flood Elevation (15-40 cfs pump) (ft-NAVD)**	**Flood Depth[(d)] (15-40 cfs pump) (ft)**	**Depth Reduction[(e)] Existing vs. Alt 3 (15-40) (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	141.50	140.92	-0.84	0.58
RC0275E_UP	MayManorHead/MayManorEast_3	141.22	141.49	140.92	-0.30	0.57
Alt3_Sump_XS	MayManorEast_3	141.09	141.49	140.92	-0.17	0.57
RC0275E_DW	MayManorEast_2	141.24	141.48	140.92	-0.32	0.56
RC0275W_UP	MayManorEast_2	141.08	141.48	140.92	-0.16	0.56
RC0275W_DW	MayManorEast	142.61	141.48	140.92	-1.69	0.56
RC0281E_UP	MayManorWest	142.01	141.47	140.92	-1.09	0.55
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	141.47	140.92	-1.69	0.55
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	141.47	140.92	-1.39	0.55
RC0320_UP	SterlingCanal	142.23	141.47	140.92	-1.31	0.55
RC0320_DW[(c)]	BridgeBlvdUS	141.78	141.46	140.92	-0.86	0.54
RC0326_UP[(c)]	BridgeBlvdDS	141.18	141.38	140.91	-0.27	0.47
RC0326_DW	MHPWeirUS	142.99	--	140.91	-2.08	--
RC0387_UP	MHPWeirDS	142.01	--	140.87	-1.14	--
RC0387_DW	WabashUS	146.90	141.21	140.86	-6.04	0.35

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 3.

The implementation of Alternative 3 will result in a decrease in flood elevations at numerous locations downstream (west) of North Wabash Avenue and a minor increase at three locations. **Appendix C** provides a summary table of the 2.33-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.3.1.2 10-Year Assessment

Illustrated on **Figure 26 Alternative 3 – 10-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 3 conditions. Referring to **Table 7-15**, the ‘Flood Depth’ column indicates that the proposed condition flood elevations at two cross-sections higher than the channel top of bank elevation. The ‘Flood Depth’ column with positive values highlighted in red indicate depth above channel bank. The values noted in red are less than 0.1 feet above the top of bank. The remainder of locations have flood elevations for this event contained within the Lake Bonnet Drain channel. Additionally, the ‘Depth Reduction’ column indicates the amount of flood elevations that were lowered under the proposed condition, in this case, approximately 1.0 feet on average at each channel location.

Proposed condition floodplain boundaries for areas located east of the May Manor bridge are completely contained within the existing channel banks except for two minor peripheral areas where there are no impacts to structures. These minor flood areas are not caused by the channel overflowing its banks but are due to low-lying areas landward of the channel where the ground elevation is lower than the channel bank elevation; thus, stormwater runoff cannot flow directly to the channel.

The south bank of Lake Bonnet Drain channel between Sterling Canal and May Manor bridge is characteristically lower than other areas. As well, areas landward of the channel are lower than their surroundings. The Alternative 3 concept specifies channel grading from the top of bank waterward with no construction of berms to raise the channel bank elevations. As illustrated, this area’s proposed condition floodplain boundaries are just slightly less extensive than the existing condition boundaries, even with an estimated 1.02 feet reduction in proposed condition flood levels (see **Table 7-15**, ‘Depth Reduction’ column, Cross-Section RC0281W). Resultant impacts in this area are considered insignificant as no structures (dwellings) are at risk, and the hydrology of the mitigation wetland contained within this area will not be affected.

As indicated at “The Bowl” in **Table 7-15**, ‘Flood Depth’ column, the estimated flood elevation is lower for the channel bank in the channel reach between Sterling Canal and May Manor bridge. As illustrated, this area’s proposed condition floodplain boundaries are less extensive than the existing condition boundaries, attributable to the estimated 1.02 feet reduction in proposed condition flood levels (see **Table 7-15**, ‘Depth Reduction’ column, Cross-Section RC0281W). It is important to note that flooding in this area is not caused by the channel overflowing its banks but is due to low-lying areas landward of the channel where the ground elevation is lower than the channel bank elevation; thus, stormwater runoff cannot flow directly to the channel. As such Alternative 3 includes two sump pump stations that will prevent this area from flooding. This effectively reduces the floodplain boundary to the Lake Bonnet Drain channel limits and eliminates the flood risks to those structures shown on the plan.

Regarding the two locations shown in **Table 7-15** where the ‘Flood Depth’ is slightly above the top of bank, it is anticipated that these minor discrepancies can be corrected as part of the channel grading required for this alternative. All remaining areas downstream of Sterling Canal experience reduced proposed condition floodplain boundaries due to the reduction of flood elevations as indicated in **Table 7-15**, ‘Depth Reduction’ column.

In conclusion, Alternative 3 meets the 10-year LOS. An additional benefit of this alternative is that backpumping to Lake Bonnet will have the effect of decreasing the duration of flooding by about 21 hours for the 10-year event.

Table 7-15 Alternative 3 Comparison 10-year Peak Stage vs Minimum Top of Channel Bank Elevation

		10-YR EXISTING CONDITION		10-YR ALTERNATIVE 3 CONDITION		
Cross-Section	Node[(a)]	TOB Elevation Min[(b)] (ft-NAVD	Existing Flood Elevation (ft-NAVD)	Flood Elevation (15-40-90 cfs pump) (ft-NAVD)	Flood Depth[(d)] (15-40-90 cfs pump) (ft)	Depth Reduction[(e)] Existing vs. Alt 3 (15-40-90) (ft)
RC0230	Brunnell DS/MayManorHead	141.76	142.23	141.16	-0.60	1.07
RC0275E_UP	MayManorHead/MayManorEast_3	141.22	142.22	141.16	-0.06	1.06
Alt3_Sump_XS	MayManorEast_3	141.09	142.22	141.16	0.07	1.06
RC0275E_DW	MayManorEast_2	141.24	142.20	141.16	-0.08	1.04
RC0275W_UP	MayManorEast_2	141.08	142.20	141.16	0.08	1.04
RC0275W_DW	MayManorEast	142.61	142.20	141.16	-1.45	1.04
RC0281E_UP	MayManorWest	142.01	142.19	141.17	-0.84	1.02
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.19	141.17	-1.44	1.02
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	142.19	141.17	-1.14	1.02
RC0320_UP	SterlingCanal	142.23	142.19	141.17	-1.06	1.02
RC0320_DW[(c)]	BridgeBlvdUS	141.78	142.18	141.17	-0.61	1.01
RC0326_UP[(c)]	BridgeBlvdDS	141.18	142.10	141.17	-0.01	0.93
RC0326_DW	MHPWeirUS	142.99	--	141.16	-1.83	--
RC0387_UP	MHPWeirDS	142.01	--	141.11	-0.90	--
RC0387_DW	WabashUS	146.90	141.83	141.10	-5.80	0.73

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 3.

The implementation of Alternative 3 will result in a decrease in flood elevations at numerous locations downstream (west) of North Wabash Avenue and a minor increase at three locations. **Appendix C** provides a summary table of the 10-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding the change in flood elevations and flood flow rates.

7.3.1.3 25-Year Assessment

Illustrated on **Figure 27 Alternative 3 – 25-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 3 conditions. Referring to **Table 7-16**, the 'Flood Depth' column indicates that the proposed condition flood elevations at five cross-sections are higher than the channel top of bank elevation. The 'Flood Depth' column with positive values highlighted in red indicate depth above channel bank. The values noted in red are less than 0.5 feet above the top of bank. The remainder of locations have flood elevations for this event contained within the Lake Bonnet Drain channel. Additionally, the 'Depth Reduction' column indicates the amount (ft) flood elevations were lowered under the proposed condition, in this case, about 1.0 feet on average at each channel location. Regarding the five locations shown in **Table 7-16** where the 'Flood Depth' is slightly above the top of bank, given the topography in this reach of the channel, it is anticipated that these minor discrepancies can be corrected as part of the channel grading required for this alternative.

Proposed condition floodplain boundaries for areas located east of the May Manor bridge are generally contained within the existing channel banks. For those areas located on the north side of the channel some minor regrading done as part of the required channel profile improvement may move the floodplain boundary to align with the top of bank. Presently there are a handful of structures within the floodplain boundary for this flood frequency. Those areas located on the south side of this channel reach experience a significant reduction in the floodplain boundary extent with flood risk being eliminated for numerous structures. May Manor recreational facilities (clubhouse, pool, etc.) remain at risk for this flood frequency.

The south bank of Lake Bonnet Drain channel between Sterling Canal and May Manor bridge is characteristically lower than other areas. As well, areas landward of the channel are lower than their surroundings. The Alternative 3 concept specifies channel grading from the top of bank waterward with no construction of berms to raise the channel bank elevations. As illustrated, this area's proposed condition floodplain boundaries are just slightly less extensive than the existing condition boundaries, even with an estimated 1.05 feet reduction in proposed condition flood levels (see **Table 7-16**, 'Depth Reduction' column, Cross-Section RC0281W). Resultant impacts in this area are not insignificant as a handful of structures experience some flood risk, however the hydrology of the mitigation wetland contained within this area will not be affected. Note that the flood risk for this area cannot be lowered without significant channel improvements that possibly involve construction of berms and sump-pump stations.

As indicated at "The Bowl" in **Table 7-16** 'Flood Depth' column, the estimated flood elevation is lower the channel bank in the channel reach between Sterling Canal and May Manor bridge. As illustrated, this area's proposed condition floodplain boundaries are less extensive than the existing condition boundaries, attributable to the estimated 1.05 feet reduction in proposed condition flood levels (see **Table 16**, 'Depth Reduction' column, Cross-Section RC0281W). It is important to note that flooding in this area in general is not caused by the channel overflowing its banks except at a minor stretch of the existing berm (approximately 20 feet) in the vicinity of the low spot referenced above. Flooding is primarily due to low lying areas landward of the channel where the ground elevation is lower than the channel bank elevation thus stormwater runoff cannot flow directly to the channel. Implementation of minor berm regrading and the two specified sump pump stations that will prevent this area from flooding. This effectively reduces the floodplain boundary to the Lake Bonnet Drain channel limits and eliminates the flood risks to those structures shown on the plan.

Regarding the locations shown on **Table 7-16** where the 'Flood Depth' is slightly above the top of bank, it is anticipated that these minor discrepancies can be corrected as part of the channel grading required for this alternative. All remaining areas downstream of Sterling Canal experience reduced proposed condition floodplain boundaries due to the reduction of flood elevations as indicated in **Table 7-16**, 'Depth Reduction' column.

In conclusion, Alternative 3 does not meet the 25-year LOS. However, with some minor modifications as described above, the risk of flooding can be eliminated for a significant number of the affected structures. An additional benefit of this alternative is that backpumping to Lake Bonnet will have the effect of decreasing the duration of flooding by about 23 hours for the 25-year event.

Table 7-16 Alternative 3 Comparison 25-Year Peak Stage versus Minimum Top of Channel Bank Elevation

		25-YR EXISTING CONDITION		25-YR ALTERNATIVE 3 CONDITION		
Cross-Section	**Node(a)**	**TOB Elevation Min(b) (ft-NAVD**	**Existing Flood Elevation (ft-NAVD)**	**Flood Elevation (15-40-90 cfs pump) (ft-NAVD)**	**Flood Depth(d) (15-40-90 cfs pump) (ft)**	**Depth Reduction(e) Existing vs Alt 3 (15-40-90 (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	142.65	141.55	-0.21	1.10
RC0275E_UP	MayManorHead/MayManorEast_3	141.22	142.64	141.54	0.32	1.10
Alt3_Sump_XS	MayManorEast_3	141.09	142.64	141.54	0.45	1.10
RC0275E_DW	MayManorEast_2	141.24	142.61	141.54	0.30	1.07
RC0275W_UP	MayManorEast_2	9141.08	142.61	141.54	0.46	1.07
RC0275W_DW	MayManorEast	142.61	142.61	141.54	-1.07	1.07
RC0281E_UP	MayManorWest	142.01	142.60	141.55	-0.46	1.05
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.60	141.55	-1.06	1.05
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	142.60	141.55	-0.76	1.04
RC0320_UP	SterlingCanal	142.23	142.59	141.55	-0.68	1.04
RC0320_DW(c)	BridgeBlvdUS	141.78	142.59	141.55	-0.23	1.04
RC0326_UP(c)	BridgeBlvdDS	141.18	142.54	141.53	0.35	1.01
RC0326_DW	MHPWeirUS	142.99	--	141.51	-1.48	--
RC0387_UP	MHPWeirDS	142.01	--	141.45	-0.56	--
RC0387_DW	WabashUS	146.90	142.20	141.43	-5.47	0.77

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 3.

The implementation of Alternative 3 will result in a decrease in flood elevations at numerous locations in downstream (west) of North Wabash Avenue, and a minor increase at 3 locations. **Appendix C** provides a summary table of the 25-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.3.1.4 100-Year Assessment

Illustrated on **Figure 28 Alternative 3 – 100-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 3 conditions. Referring to **Table 7-17**, the 'Flood Depth' column indicates that the proposed condition flood elevations at ten (10) of the 15 are higher than the channel top of bank elevation between 0.26 feet to 1.41 feet with an average overtopping depth of 0.92 feet. The 'Flood Depth' column with positive values highlighted in red indicate depth above channel bank. The remainder of locations have flood elevations for this event that are contained within the Lake Bonnet Drain channel. Additionally, the 'Depth Reduction' column indicates the amount of flood elevations that were lowered under proposed condition pumping, in this case about 1.0 foot on average at each channel location.

Proposed condition floodplain boundaries for areas located east of the May Manor bridge are generally well outside of the channel with some minimal reduction in their extent due to the 1-foot reduction in flood elevation. The level of flood risk reduction in this area is minimal.

The south bank of Lake Bonnet Drain channel between Sterling Canal and May Manor bridge is characteristically lower than other areas. As well, areas landward of the channel are lower than their surroundings. The Alternative 3 concept specifies channel grading from the top of bank waterward with no construction of berms to raise the channel bank elevations. As illustrated, this area's proposed condition floodplain boundaries are just slightly less extensive than the existing condition boundaries, even with an estimated 0.99-foot reduction in proposed condition flood levels (see **Table 7-17**, 'Depth Reduction' column, Cross-Section RC0281W). Resultant impacts in this area are insignificant as only a small number of structures experience a reduction in flood risk, however the hydrology of the mitigation wetland contained within this area will not be affected. Note that flood risk for this area cannot be lowered without significant channel improvements that possible involve construction of berms and sump pump stations.

In conclusion, Alternative 3 does not meet the 100-year LOS. However, the proposed backpumping to Lake Bonnet will have the effect of decreasing the duration of flooding by about 22 hours for the 100-year event.

Table 7-17 Alternative 3 Comparison 100-Year Peak Stage vs Minimum Top of Channel Bank Elevation

		100-YR EXISTING CONDITION		100-YR ALTERNATIVE 3 CONDITION		
Cross-Section	Node[a]	TOB Elevation Min[b] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Flood Elevation (15-40-90 cfs pump) (ft-NAVD)	Flood Depth[d] (15-40-90 cfs pump) (ft)	Depth Reduction[e] Existing vs Alt 3 (15-40-90 (ft)
RC0230	Brunnell DS/MayManorHead	141.76	143.54	142.50	0.74	1.04
RC0275E_UP	MayManorHead/MayManorEast_3	141.22	143.52	142.49	1.27	1.03
Alt3_Sump_XS	MayManorEast_3	141.09	143.52	142.49	1.40	1.03
RC0275E_DW	MayManorEast_2	141.24	143.49	142.49	1.25	1.00
RC0275W_UP	MayManorEast_2	141.08	143.49	142.49	1.41	1.00
RC0275W_DW	MayManorEast	142.61	143.48	142.49	-0.12	0.99
RC0281E_UP	MayManorWest	142.01	143.47	142.48	0.47	0.99
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	143.47	142.48	-0.13	0.99
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	143.47	142.48	0.17	0.99
RC0320_UP	SterlingCanal	142.23	143.47	142.48	0.25	0.99
RC0320_DW(c)	BridgeBlvdUS	141.78	143.46	142.48	0.70	0.98
RC0326_UP(c)	BridgeBlvdDS	141.18	143.44	142.44	1.26	1.00
RC0326_DW	MHPWeirUS	142.99	--	142.39	-0.60	--
RC0387_UP	MHPWeirDS	142.01	--	142.27	0.26	--
RC0387_DW	WabashUS	146.90	142.98	142.22	-4.68	0.76

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 3.

The implementation of Alternative 3 will result in a decrease in flood elevations at numerous locations in downstream (west) of North Wabash Avenue. **Appendix C** provides a summary table of the 100-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.3.1.5 Alternative 3 Assessment Summary

Implementation of Alternative 3 proposed floodplain mitigation improvements provide a LOS up to and including the 10-year event. It is important to note the assessment does not consider the 1-foot of freeboard as a factor of safety. The 25-year and 100-year LOS was not attained. However, with some minor modifications as described above a significant number of the affected structures can be eliminated from a risk of flooding. **Table 7-18** presents a comparison of the number of structures affected (within floodplain boundary) under existing conditions versus the number of structures affected under proposed conditions within the Project Area. A comparison is provided for each flood event ranging from the 2.33-year (mean annual) through 100-year event.

Table 7-18 Alternative 3 Affected Structures within Project Area Summary

Affected Structures	Flood Frequency				
	100-year	25-year		10-year	2.33-year
Existing	220	154		108	43
Proposed	132	41(a)	19(b)	6	1
% Improvement	40%	73%(a)	88%(b)	94%	98%

Note: Structures include mobile homes and park facilities.

(a) As proposed.

(b) With minor embankment repairs.

7.3.2 Offsite Impacts (Flood Levels and Flows)

The flood elevation and flow rate information presented in this section is important to the assessment of potential structural (buildings, roads, bridges, utilities, etc.), and environmental impacts. The type of features impacted, and the magnitude of the impacts is critical to Stormwater, Environmental, Floodplain Management and other permits that will be required for this Project. Impact information is presented individually for each of the four flood frequency events considered as part of the Project.

Implementation of Alternative 3 proposed floodplain mitigation improvements within the Project Area result in some offsite impacts in the reach of Lake Bonnet Drain downstream of North Wabash Avenue. These impacts include changes in flood elevation and flood flow rates. **Appendix C** contains a model results summary comparison of existing condition versus proposed alternative condition 'Max Stage' (flood elevation) and 'Max Total Inflow Rate' (flood flow rate). The summary table has been formatted to highlight (red) nodes that experience an increase in flood elevation and highlight (green) nodes that experience an increase in flood flow Rate.

Figures 37 through 40 illustrate the disposition of each node (entire model domain) with respect to changes in flood elevation and flow rate. Specifically, Red symbols indicate locations (nodes) that increase both in flood elevation and flood flow rate, Orange symbols indicate locations that increase in flood elevation only, Blue symbols indicate locations that increase in flood flow rate only, and for reference only, Green symbols indicate locations with no flood elevation or flood flow rate increase.

Selected node locations (directly adjacent to the Lake Bonnet Drain channel) as shown in the figures have been identified by name to correlate with the nodes in the tables identified in **Appendix C**. The tables provide the summary results of the entire model network stages and flows.

Table 7-19 provides a summary of the number of model locations (west of N. Wabash Ave.) where flood elevation and flow rate change relative to existing conditions due to implementation of Alternative 3.

Table 7-19 Offsite Impacts Alternative 3 - Change in Model Flood Elevation and Flow Rate (1)

Event Frequency	Stg +, Flow +	Stg +, Flow 0	Stg 0, Flow +	Stg 0, Flow 0
100-year	0	0	6	81
25-year	0	0	12	75
10-year	0	0	4	83
2.33-year	0	0	0	87

(1) Indicates the number of model locations where flood elevation and flow rate change relative to existing conditions for areas west of N. Wabash Ave.

7.3.3 Engineer's Opinion of Probable Cost (EOPC)

The EOPC for Alternative 3 is $20.3M. Of the total cost, $7.3M will be dedicated to construction activities related to the dredging/ sediment removal in Lake Bonnet. The lake dredging as presented in the report will lower the normal water level 1-foot lower than the present level to create additional storage volume required to accommodate backpumped volumes from Lake Bonnet Drain.

Similar to all the alternatives, the long-term operation and maintenance should be considered. There are one pump station, two sump pumps stations, and the storm drainage system that will convey stormwater to the sump pumps that will require maintenance. There will be routine maintenance such as removing debris and sediment within Lake Bonnet Drain and maintaining the pump facilities such as exercising the generators and pumps and maintaining the access path leading to the sump pumps. Also, a nearby location will have to be identified to store spare parts for the pump equipment.

The City of Lakeland will need in-house staff or outside consultant with technical expertise to diagnose, repair, operate and maintain the sump pumps.

The pump station and sump pumps will be an added expense and should be factored into the City's budget prior to selecting the alternative.

7.3.4 Permit Issues, Mitigation Requirements, and Feasibility

Alternative 3 would require the construction of a floodwall along portions of the Lake Bonnet Drain channel and would involve lowering the level of Lake Bonnet by one foot or less. The lowering of the lake would allow increased capacity for storage of stormwater. Stormwater would be backpumped into Lake Bonnet from Lake Bonnet Drain channel. An approximately 1,200 square foot pump station would be sited west of the Brunnell Parkway within W14. The littoral area of Lake Bonnet would be regraded to maintain the same area of littoral area, approximately 11.17 acres, in the lowered water level condition as currently exists.

Regrading of the littoral shelf would likely not require mitigation as the function of the littoral shelf will be replaced by the restored littoral area. The restored littoral area is likely to have higher wetland function due to the removal of nuisance and exotic species that currently are found along the lakes littoral shelf. The littoral shelf will need to be maintained, possibly in perpetuity, and the regulatory agencies may require a long-term maintenance plan to be implemented.

W14 will be impacted directly by the construction of the pump station. **Table 7-20** details the preliminary range of wetland functional loss assessed for direct impacts to W14.

Table 7-20 Range of Wetland Functional Loss Assessed for Direct Wetland Impacts to W14 for Alternative 3

Assessment Area	Wetland Function			UMAM Delta (Score)	Impact (Acre)	Range of Functional Loss
	Location and Landscape	Water Environment	Community Structure			
W14	6 to 7	7 to 8	7 to 8	0.66 to 0.77	0.03	0.02 to 0.03

Estimated mitigation costs for the direct impact to W14 range from $2,475 to $3,465. Most mitigation banks charge a minimum fee that can range from $5,000 to $10,000 or more.

Both USACE and SWFWMD will require assurances that lowering the normal water level of Lake Bonnet will not cause adverse effects to Wetland 8 (W8), Wetland 15 (W15), and wetlands within Bonnet Springs Park. During the permitting phase, detailed modeling will be required to show that lowering the current water level will not cause adverse effects. In addition, the regulatory agencies may require long-term monitoring to ensure that W8 could adjust to lower water levels.

Should the change in water level within Lake Bonnet prove to be an impact for W8, mitigation may be required. Prior to assessing mitigation, operational strategies such as lowering water levels during certain periods of the year will be analyzed. Therefore, additional mitigation costs, if any, will be assessed during the design phase.

The water quantity and water quality requirements for Alternative 3 are the same as those described for Alternatives 1 and 2. The difference is that increases in water stages and flows occur at fewer nodes downstream of the project reach for Alternative 3. This occurs because the Lake Bonnet Drain channel is graded eastward to a pump station at the upstream end of the channel adjacent to North Brunnell Parkway in this alternative. A pump station with a 65 million gallons per day (MGD) pump conveys the water to Lake Bonnet. The storage capacity in Lake Bonnet is increased because the normal water level in Lake Bonnet is lowered by no more than 1 foot. The SWFWMD requires no increases in water stages in offsite properties. However, fewer increases at offsite drainage nodes should assist in demonstrating no adverse impacts to offsite properties as described for Alternatives 1 and 2. The model indicates water stages in Lake Bonnet do not increase, which should facilitate the permitting process.

Another permitting issue is that the flood control is based on pumping water into Lake Bonnet. The SWFWMD will require a detailed plan demonstrating the pump station is reliable and will operate when needed. The information they request could include operating schedules for the pump, power supply, emergency power supply from generators, maintenance schedule, and the entity providing the maintenance.

7.3.5 Dredging of Lake Bonnet

Dredging of Lake Bonnet, or portions thereof, in conjunction with Alternative 3 would require the development of an SMF. The location for staging the SMF is limited due to lack of right-of-way, existing single-family homes, multi-family residential, and Bonnet Springs Park. Therefore, the SMF has been sited along the southeastern quadrant of the lake. The SMF is needed for dredged material handling and transportation off-site for disposal. Two conceptual SMF designs were analyzed: single and bifurcated.

Both conceptual SMF designs would impact Wetland 8 (W8). W8 is a large wetland area located between the open water of Lake Bonnet and the upland habitat along the eastern portion of the lake. The single SMF would impact 6.3 acres of wetland habitat, and the bifurcated SMF would impact 3.8 acres. The wetland would be restored post-dredging activities. Although impacts would be temporary, additional mitigation in excess of onsite restoration would still be required due to the time needed for the area to develop into a mature forested wetland, which exists today. The time to develop into mature forested wetland system is approximately 21 to 25 years based on the current vegetation composition of W8.

UMAM scores were assessed during the permitting phase of Bonnet Springs Park (adjacent to the east of Lake Bonnet). These scores were used as a baseline as the habitat throughout W8 is similar. During the design phase, a detailed UMAM analysis will be conducted to determine the functional value of each wetland. **Table 7-21** details the range of wetland functional loss for direct impacts for W8 per preliminary analysis.

Table 7-21 Range of Wetland Functional Loss Assessed for Direct Wetland Impacts for the Dredging Alternative

Assessment Area	Wetland Function			UMAM Delta (Score)	Impact (Acre)	Range of Functional Loss
	Location and Landscape	Water Environment	Community Structure			
Single SMF	5	3	6	0.47	6.3	2.96
Bifurcated SMF	5	3	6	0.47	3.8	1.79

Wetland habitat will be restored, but the restored wetland will not fully replace the lost value of the wetland impact until the forested system has matured. Two additional factors are considered to determine the amount of wetland functional improvement due to restoration, also known as relative functional gain, generated by the restoration of W8.

- Time lag: the period between when the functions are lost and the time when those functions are fully replaced. The USACE and the SWFWMD apply different time-lag values, resulting in slightly different amounts of relative functional gain.
- Risk: the degree of uncertainty of achieving full replacement of lost functions. During the design phase, activities that can be used to reduce risk will be evaluated. Activities to reduce risk will have an associated cost that will be weighed against the overall mitigation obligation.

Table 7-22 details the range of wetland relative functional gain for the restoration of W8.

Table 7-22 Wetland Relative Functional Gain for the Restoration of W8

Assessment Area	Wetland Function			UMAM Delta (Score)	Impact (Acre)	Time Lag	Risk	Range of Relative Functional Gain
	Location and Landscape	Water Environment	Community Structure					
State								
Single SMF	5	3	6	0.47	6.3	1.92	1.5	1.02
Bifurcated SMF	5	3	6	0.47	3.8	1.92	1.5	0.62
Federal								
Single SMF	5	3	6	0.47	6.3	1.478	1.5	1.33
Bifurcated SMF	5	3	6	0.47	3.8	1.478	1.5	0.80

The difference between the functional loss and the relative functional gain would need to be mitigated at an offsite mitigation bank. Currently, freshwater forested credits range from $125,000 to $150,000 per credit. Therefore, mitigation costs, if dredging is included, would range from $146,250 to $291,000. These costs do not include the cost of restoring the wetland and long-term maintenance and monitoring that will need to be conducted until the wetland has achieved the full replacement of wetland function. During design, additional methods to reduce wetland impacts will be evaluated such as staging the SMF within the limits of Lake Bonnet on barges or similar platforms or other suitable staging area(s) outside the limits of agency jurisdictional wetlands.

7.3.6 FEMA Compliance

Refer to **Section 6.2.5**.

7.3.7 Property/ Right-Of-Way (ROW) Requirements

Similar to Alternatives 1 and 2, construction activity for Alternative 3 is limited to Sterling Homes and May Manor properties. The City of Lakeland will need to obtain consent and permission from Sterling Homes and May Manor to perform the work under this alternative.

Shoreline stabilization of Lake Bonnet will encroach on private properties adjacent to the lake and work within the North Brunnell Parkway ROW. Therefore, permission will be required from private properties that will be affected by the shoreline stabilization activity.

Temporary construction easements and permanent easements for access and maintenance are required for the alternative. Refer to **Section 6.2.6** for additional details.

7.3.8 Constructability

Refer to **Section 6.1.7**.

7.4 Alternative 4 – Detention (Pond/ Underground Storage)

As detailed in **Section 5.4**, this detention storage alternative was designed to provide flood protection in the May Manor and Sterling Park areas by the addition of detention storage facilities, including underground vaults and a pond. As illustrated in **Figure 15 Alternative 4 - Detention (Pond/ Underground Storage)**, this alternative includes the construction of three buried storage vault systems and associated pump systems for inflow and discharge control. Two vault systems are to be located within the Lake Bonnet Drain channel proper and one vault system will be located adjacent to and north of the channel. Also illustrated is a stormwater detention pond located on the present site of the McKeel Academy of Technology School on the north side of May Manor MHP. This alternative will not require revisions to the Lake Bonnet Drain channel profile or cross-section geometry except for the installation of the vault systems.

7.4.1 Performance/Level of Service (LOS)/Effectiveness at Mitigation

The LOS for each alternative was determined from the results of hydrologic modeling studies (described in **Section 4**). Estimated flood stages for each of the modeled flood frequencies were used to develop floodplain boundary maps and summary tables discussed in this section.

7.4.1.1 2.33-Year (Mean Annual) Assessment

Illustrated on **Figure 29 Alternative 4 – Mean Annual (2.33-Year) Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 4 conditions. Proposed condition floodplain boundaries in the Project Reach between N. Brunnell Parkway and Sterling Canal are modestly reduced when compared to existing condition boundaries, and only a few structures receive flood risk reduction in this area. The remaining Project Reach downstream of Sterling Canal also receive a modest reduction in proposed condition floodplain boundaries. This area with only few structures at risk of flooding for the 2.33-year event had no additional structures removed for flood risk under proposed conditions.

Referring to the 'Flood Depth' column in **Table 7-23**, the proposed condition flood elevations at four of the twelve cross-sections within the Project Reach are greater than the existing condition top of bank elevations. The remaining cross-section locations all exhibit proposed condition flood elevations below the existing condition top of bank elevations. The Lake Bonnet Drain system (channel and overbank) is characterized as being low lying with landward areas adjacent to the channel being lower than the channel banks. As a result, areas outside of the channel experience flooding even when water levels in the channel are below the top of bank elevation. Stormwater runoff within these areas must stage up to the top of bank elevation before drainage occurs. This is the primary cause of flooding in the Project Reach between N. Brunnell Parkway and Sterling Canal.

The Alternative 4 concept includes no channel grading or other improvements such as raising berms or providing sump-pump systems that could convey water impounded behind the channel banks to the channel proper. As demonstrated in **Table 7-23** even when flood elevations within the channel are lower than the top of bank elevation, areas adjacent to the channel are still subject to flooding.

In conclusion, Alternative 4 does not meet the 2.33-year (mean annual) LOS.

Table 7-23 Alternative 4 Comparison 2.33-Year Peak Stage versus Top of Channel Bank Elevation

		2.33-YR EXISTING CONDITION		**2.33-YR ALTERNATIVE 4 CONDITION**		
Cross-Section	**Node[a]**	**TOB Elevation Min[b] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[d] (ft)**	**Depth Reduction[e] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	141.50	141.37	-0.39	**-0.13**
RC0275E_UP	MayManorHead	141.22	141.49	141.37	0.15	**-0.12**
RC0275E_DW	MayManorEast_2	141.24	141.48	141.36	0.12	**-0.12**
RC0275W_UP	MayManorEast_2	141.08	141.48	141.36	0.28	**-0.12**
RC0275W_DW	MayManorEast	142.61	141.48	141.35	-1.26	**-0.13**
RC0281E_UP	MayManorWest	142.01	141.47	141.35	-0.66	**-0.12**
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	141.47	141.35	-1.26	**-0.12**
RC0281W	SterlingCanal_East/SterlingCanal (Lt 139.56,Rt 142.31)	142.31	141.47	141.35	-0.97	**-0.13**
RC0320_UP	SterlingCanal	142.23	141.47	141.34	-0.89	**-0.13**
RC0320_DW[c]	BridgeBlvdUS	141.78	141.46	141.34	-0.44	**-0.12**
RC0326_UP[c]	BridgeBlvdDS	141.18	141.38	141.29	0.11	**-0.09**
RC0387_DW	WabashUS	146.90	141.21	141.19	-5.71	**-0.02**

(a) Model node, results used to determine existing and proposed flood elevations.
(b) Existing top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 4.

The implementation of Alternative 4 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. Please refer to **Appendix C** (Sheets 54-57), 2.33-year event for a summary of maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.
10-Year Assessment

Illustrated on **Figure 30 Alternative 4 - 10-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 4 conditions. Proposed condition floodplain boundaries in the Project Reach between North Brunnell Parkway and Sterling Canal are modestly reduced when compared to existing condition boundaries, and only a few structures receive flood risk reduction in this area. The remaining Project Reach downstream of Sterling Canal also receives a modest reduction in proposed condition floodplain boundaries. This area with only few structures at risk of flooding for the 10-year event had no additional structures removed for flood risk under proposed conditions.

Referring to the 'Flood Depth' column in **Table 7-24** below, the proposed condition flood elevations at six (6) of the twelve (12) cross-sections within the Project Reach are greater than the existing condition top of bank elevations. The remaining cross-section locations all exhibit proposed condition flood elevations below the existing condition top of bank elevations. The Lake Bonnet Drain system (channel and overbank) is characterized as being low lying with landward areas adjacent to the channel being lower than the channel banks. As a result, areas outside of the channel experience flooding even when water levels in the channel are below the top of bank elevation. Runoff water within these areas must stage up to the top of bank elevation before drainage occurs. This is the primary cause of flooding in the Project Reach between North Brunnell Parkway and Sterling Canal.

The Alternative 4 concept includes no channel grading or other improvements such as raising berms or providing sump-pump systems that could convey water impounded behind the channel banks to the channel proper. As demonstrated in **Table 7-24** even when flood elevations within the channel are lower than the top of bank elevation, areas adjacent to the channel are still subject to flooding.

In conclusion Alternative 4 does not meet a 10-year LOS.

Table7-24 Alternative 4 Comparison 10-year Peak Stage versus Minimum Top of Channel Bank Elevation

		10-YR EXISTING CONDITION		10-YR ALTERNATIVE 4 CONDITION		
Cross-Section	Node[a]	TOB Elevation Min[b] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth[d] (ft)	Depth Reduction[e] (ft)
RC0230	Brunnell DS/MayManorHead	141.76	142.23	141.98	0.22	-0.24
RC0275E_UP	MayManorHead	141.22	142.22	141.97	0.75	-0.25
RC0275E_DW	MayManorEast_2	141.24	142.20	141.95	0.71	-0.25
RC0275W_UP	MayManorEast_2	141.08	142.20	141.95	0.87	-0.25
RC0275W_DW	MayManorEast	142.61	142.20	141.95	-0.66	-0.25
RC0281E_UP	MayManorWest	142.01	142.19	141.94	-0.07	-0.25
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.19	141.94	-0.67	-0.25
RC0281W	SterlingCanal_East/Sterling Canal (Lt 139.56,Rt 142.31)	142.31	142.19	141.94	-0.37	-0.25
RC0320_UP	SterlingCanal	142.23	142.19	141.94	-0.29	-0.25
RC0320_DW[c]	BridgeBlvdUS	141.78	142.18	141.94	0.16	-0.24
RC0326_UP[c]	BridgeBlvdDS	141.18	142.10	141.84	0.66	-0.26
RC0387_DW	WabashUS	146.90	141.83	141.72	-5.18	-0.11

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Existing top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 4.

The implementation of Alternative 4 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. Please refer to **Appendix C** (Sheets 58-61), 10-year event for a summary of maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.4.1.2 25-Year Assessment

Illustrated on **Figure 31 Alternative 4 - 25-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 4 conditions. Proposed condition floodplain boundaries in the Project Reach between North Brunnell Parkway and Sterling Canal are modestly reduced when compared to existing condition boundaries, and only a few structures receive flood risk reduction in this area. The remaining Project Reach downstream of Sterling Canal experienced a more substantial reduction in proposed condition floodplain boundaries. In this area, where several structures are at risk of flooding during a 25-year event, the majority of these structures would no longer be at risk under the proposed conditions.

Referring to the ‘Flood Depth’ column in **Table 7-25** below, the proposed condition flood elevations at eight (8) of twelve (12) cross-sections within the Project Reach are greater than the existing condition top of bank elevations. The remaining cross-section locations all exhibit proposed condition flood elevations below the existing condition top of bank elevations. The Lake Bonnet Drain system (channel and overbank) is characterized as being low-lying, with landward areas adjacent to the channel being lower than the channel banks. As a result, areas outside of the channel experience flooding even when water levels in the channel are below the top of bank elevation. Runoff water within these areas must stage up to the top of bank elevation before drainage occurs. This is the primary cause of flooding in the Project Reach between North Brunnell Parkway and Sterling Canal.

The Alternative 4 concept includes no channel grading or other improvements such as raising berms or providing sump-pump systems that could convey water impounded behind the channel banks to the channel proper. As demonstrated in **Table 7-25,** even when flood elevations within the channel are lower than the top of bank elevation, areas adjacent to the channel are still subject to flooding.

In conclusion, Alternative 4 does not meet a 25-year LOS.

Table 7-25 Alternative 4 Comparison 25-year Peak Stage versus Minimum Top of Channel Bank Elevation

		25-YR EXISTING CONDITION		25-YR ALTERNATIVE 4 CONDITION		
Cross-Section	Node[a]	TOB Elevation Min[b] (ft-NAVD)	Existing Flood Elevation (ft-NAVD)	Flood Elevation (ft-NAVD)	Flood Depth[d] (ft)	Depth Reduction[e] (ft)
RC0230	Brunnell DS/MayManorHead	141.76	142.65	142.30	0.54	**-0.35**
RC0275E_UP	MayManorHead	141.22	142.64	142.29	1.07	**-0.35**
RC0275E_DW	MayManorEast_2	141.24	142.61	142.27	1.03	**-0.34**
RC0275W_UP	MayManorEast_2	141.08	142.61	142.27	1.19	**-0.34**
RC0275W_DW	MayManorEast	142.61	142.61	142.26	-0.35	**-0.35**
RC0281E_UP	MayManorWest	142.01	142.60	142.26	0.25	**-0.34**
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	142.60	142.25	-0.36	**-0.35**
RC0281W	SterlingCanal_East/Sterling Canal (Lt 139.56,Rt 142.31)	142.31	142.60	142.25	-0.06	**-0.34**
RC0320_UP	SterlingCanal	142.23	142.59	142.25	0.02	**-0.34**
RC0320_DW[c]	BridgeBlvdUS	141.78	142.59	142.25	0.47	**-0.34**
RC0326_UP[c]	BridgeBlvdDS	141.18	142.54	142.20	1.02	**-0.34**
RC0387_DW	WabashUS	146.90	142.20	142.02	-4.88	**-0.18**

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Existing top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 4.

The implementation of Alternative 4 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. Please refer to **Appendix C** (Sheets 62-65), 25-year event for a summary of maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment provides additional details regarding increased flood elevations and flood flow rates.

7.4.1.3 100-Year Assessment

Illustrated on **Figure 32 Alternative 4 - 100-Year Event Floodplain Map** are floodplain boundaries for existing and proposed Alternative 4 conditions. Proposed condition floodplain boundaries in the Project Reach between N. Brunnell Parkway and Sterling Canal are modestly reduced when compared to existing condition boundaries, and only a few structures receive flood risk reduction in this area. The remaining Project Reach downstream of Sterling Canal also receives a modest reduction in proposed condition floodplain boundaries. This area with several structures at risk of flooding for the 100-year event had very limited number of structures removed from flood risk under proposed conditions.

Referring to the ‘Flood Depth’ column in **Table 7-26** below, the proposed condition flood elevations at all but one (1) cross-section within the Project Reach are greater than the existing condition top of bank elevations. The Lake Bonnet Drain system (channel and overbank) is characterized as being low-lying, with landward areas adjacent to the channel being lower than the channel banks. As a result, areas outside of the channel experience flooding even when water levels in the channel are below the top of bank elevation. Runoff water within these areas must stage up to the top of bank elevation before drainage occurs. This is the primary cause of flooding in the Project Reach between N. Brunnell Parkway and Sterling Canal.

The Alternative 4 concept includes no channel grading or other improvements, such as raising berms or providing sump-pump systems that could convey water impounded behind the channel banks to the channel proper. In the case of the 100-year flood event with the majority of the channel experiencing flood levels above the top of bank elevation, sump-pump systems would be ineffective at removing local drainage in low areas upland of the channel banks.

In conclusion, Alternative 4 does not meet a 100-year LOS.

Table 7-26 Alternative 4 Comparison 100yr Peak Stage vs. Minimum Top of Channel Bank Elevation

		100-YR EXISTING CONDITION		100-YR ALTERNATIVE 4 CONDITION		
Cross-Section	**Node[(a)]**	**TOB Elevation Min[(b)] (ft-NAVD)**	**Existing Flood Elevation (ft-NAVD)**	**Flood Elevation (ft-NAVD)**	**Flood Depth[(d)] (ft)**	**Depth Reduction[(e)] (ft)**
RC0230	Brunnell DS/MayManorHead	141.76	143.54	143.03	1.27	**0.51**
RC0275E_UP	MayManorHead	141.22	143.52	143.00	1.78	**0.52**
RC0275E_DW	MayManorEast_2	141.24	143.49	142.396	1.72	**0.53**
RC0275W_UP	MayManorEast_2	141.08	143.49	142.96	1.88	**0.53**
RC0275W_DW	MayManorEast	142.61	143.48	142.95	0.34	**0.53**
RC0281E_UP	MayManorWest	142.01	143.47	142.95	0.94	**0.52**
RC0281E_DW	SterlingCanal_East (Lt 139.06,Rt 142.61)	142.61	143.47	142.94	0.33	**0.53**
RC0281W	SterlingCanal_East/Sterling Canal (Lt 139.56,Rt 142.31)	142.31	143.47	142.94	0.63	**0.53**
RC0320_UP	SterlingCanal	142.23	143.47	142.94	0.71	**0.53**
RC0320_DW[(c)]	BridgeBlvdUS	141.78	143.46	142.94	1.16	**0.52**
RC0326_UP[(c)]	BridgeBlvdDS	141.18	143.44	142.91	1.73	**0.53**
RC0387_DW	WabashUS	146.90	142.98	142.68	-4.22	**0.30**

(a) Model node, results used to determine existing and alternative flood elevations.
(b) Existing top-of-Bank elevation at cross-section location.
(c) Cross-section in proposed condition only.
(d) Depth of flooding above Top-of-Bank.
(e) Reduction in flood depth Existing vs Alternative 4.

The implementation of Alternative 4 will result in increased flood elevations and flood flow rates in certain downstream areas located west of North Wabash Avenue. **Appendix C** provides a summary table of the 100-year event of the maximum peak stage and flow rate differences for all node locations within the model domain. The Offsite Impacts (flood levels and flows) Assessment below will provide additional details regarding increased flood elevations and flood flow rates.

7.4.1.4 Alternative 4 Assessment Summary

Implementation of Alternative 4 proposed floodplain mitigation improvements do not provide a LOS for any of the flood events under consideration. **Table 7-27** presents a comparison of the number of structures affected (within floodplain boundary) under existing conditions versus the number of structures affected under proposed conditions within the Project Area. A comparison is provided for each flood event ranging from the 2.33-year (mean annual) through 100-year event.

Table7-27 Alternative 4 Affected Structures within Project Area Summary

Affected Structures	Flood Frequency			
	100-year	**25-year**	**10-year**	**2.33-year**
Existing	220	154	108	43
Proposed	177	113	76	26
% Improvement	20%	27%	30%	40%

Note: Structures include mobile homes and park facilities.

7.4.2 Offsite Impacts (Flood Levels and Flows)

The flood elevation and flow rate information presented in this section is important to the assessment of potential structural (buildings, roads, bridges, utilities, etc.), and environmental impacts. The type of features impacted, and the magnitude of the impacts are critical to Stormwater, Environmental, Floodplain Management, and other permits that will be required for this project. Potential impacts are presented below for each of the four flood frequency events.

Implementation of Alternative 4 proposed floodplain mitigation improvements within the Project Area result in some offsite impacts in the reach of Lake Bonnet Drain downstream of North Wabash Avenue. These impacts include changes in flood elevation and flood flow rates. **Appendix C** contains the model results summary comparison of existing condition versus proposed alternative condition 'Max Stage' (flood elevation) and 'Max Total Inflow Rate' (flood flow rate). The summary table has been formatted to highlight (red) nodes that experience an increase in flood elevation and highlight (green) nodes that experience an increase in flood flow Rate.

Figures 45 through 48 illustrate the disposition of each node (entire model domain) with respect to changes in flood elevation and flow rate. Specifically, Red symbols indicate locations (nodes) that increase both in flood elevation and flood flow rate, Orange symbols indicate locations that increase in flood elevation only, Blue symbols indicate locations that increase in flood flow rate only, and for reference only, Green symbols indicate locations with no flood elevation or flood flow rate increase.

Selected node locations (directly adjacent to the Lake Bonnet Drain channel), as shown in the figures, have been identified by name to correlate with the nodes in the tables identified in **Appendix C**. The tables provide the summary results of the entire model network stages and flows.

Table 7-28 provides a summary of the number of model locations (west of N. Wabash Ave.) where flood elevation and flow rate change relative to existing conditions due to implementation of Alternative 4.

Table 7-28 Offsite Impacts Alternative 4 - Change in Model Flood Elevation and Flow Rate (1)

Event Frequency	Stg +, Flow +	Stg +, Flow 0	Stg 0, Flow +	Stg 0, Flow 0
100-year	0	17	7	64
25-year	0	9	2	77
10-year	2	37	0	49
2.33-year	5	40	1	42

Notes:

(1) Indicates the number of model locations where flood elevation and flow rate change relative to existing conditions for areas west of N. Wabash Ave.

7.4.3 Engineer's Opinion of Probable Cost (EOPC)

The EOPC for Alternative 4 is $39.7M, which is the highest when compared to other Alternatives and exceeds the available budget of $33.6M. The cost is primarily driven by the construction of the detention pond and underground detention vaults.

Similar to all the Alternatives, the long-term operation and maintenance should be considered. There are three sump pumps; each is dedicated to an underground detention vault to pump flood water into the vault during a storm event and to pump water out from the vault after a storm.

There will be routine maintenance such as removing debris and sediment within Lake Bonnet Drain, detention pond, and underground detention vaults and maintaining the pump facilities such as exercising the generators and pumps and maintaining the access path leading to the detention structures and sump pumps. Also, a nearby location will have to be identified to store spare parts for the pump equipment.

The City of Lakeland will need in-house staff or outside consultant with technical expertise to diagnose, repair, operate and maintain the sump pumps.

The sump pumps are an added expense and should be factored into the City's budget prior to selecting the alternative.

7.4.4 Permit Issues, Mitigation Requirements, and Feasibility

Alternative 4 would create additional storage within an underground and above-ground (Pond) detention system. Similar to Alternatives 1 and 2, most of the proposed impacts resulting from Alternative 4 are within the Lake Bonnet Drain channel. Construction of the proposed underground detention system could impact portions of W12 and W13. Therefore, this alternative would be expected to have similar mitigation costs to Alternatives 1 and 2, ranging from an estimated $42,000 to $115,000.

During the design phase, impacts to the wetlands will be avoided or minimized to the greatest extent practicable. Impacts to W12 and W13 could be considered temporary if wetland habitat is restored to pre-existing conditions. Although there may be a time-lag assessment that would necessitate some mitigation to account for the loss in time of wetland function. Further analysis is needed to determine if the placement of the underground detention system under wetland habitat would have permanent adverse impacts to the overlying wetlands requiring mitigation. This analysis would occur during the design and permitting phase of the project.

The water quantity and water quality requirements for Alternative 4 are the same as those described for Alternatives 1 and 2. Alternative 4 has the most off-site nodes outside the channel where stages increase. The storage is provided in three below-ground underground detention systems and one above-ground pond. The below-ground detention systems are dependent upon pumps removing water where the storage volume is available. Therefore, Alternative 4 will be the most difficult alternative to obtain a permit due to the number of increased water stages in off-site nodes and the underground detention systems.

7.4.5 FEMA Compliance

Refer to **Section 6.1.5**.

7.4.6 Property/ Right-Of-Way (ROW) Requirements

Alternative 4 will require permission from Sterling Homes and May Manor to install underground vaults on the properties. In addition, permission will be required to utilize the playing field at McKeel Academy of Technology to construct a detention pond to temporarily collect and store flood water prior to discharging into the Lake Bonnet Drain. Note that after the construction of the detention pond, the playing field will maintain its intended function except during storm events.

Temporary construction easements and permanent easements for access and maintenance are required for the alternative. Refer to **Section 6.2.6** for additional details.

7.4.7 Constructability

Refer to **Section 6.1.7**.

8. Guidance for Alternative Selection – Decision Matrix

8.1 Introduction

Each alternative was scored by assigning a value (1-20) to each assessment component. The values were summed to create a total score for each alternative. Scoring for each criterion was roughly defined as follows to subsequently select an alternative with the highest probability of success:

16-20: Strongly recommended. Values within this range indicate that this alternative is an excellent option based on the criterion. Values within this range indicate that the alternative is constructible, uses a proven strategy for risk mitigation, has been applied to similar environments, has little uncertainty, is predictable, resilient to long-term and short-term condition changes, and will stay on budget as designed and estimated. Land is available and suitable for equipment staging and/or sediment processing with no additional engineering support or costs. There is a low probability of project delay as materials and equipment for this alternative are readily available, and there are no long lead items. Results of the dewatering strategy will be adequate and transport to a final disposal area is achievable. Regulatory acceptance is expected.

11-15: Recommended. Values within this range indicate that this alternative is a recommended option based on the criterion. Values within this range indicate that the alternative is constructible, uses a proven strategy for risk mitigation, has been applied to similar environments, has minimal uncertainty, is predictable and resilient to long-term condition changes, and has a low probability of change orders. Land is available and suitable for equipment staging and/or sediment processing with additional engineering support and costs. There is a low probability of project delay as materials and equipment for this alternative are readily available, and there are no long lead items. The results of the dewatering strategy will be adequate, and transport to a final disposal area is achievable with few challenges. Regulatory acceptance is expected.

6-10: Acceptable but with several challenges. Values within this range indicate that this alternative is acceptable but has several challenges that can be mitigated with engineering and BMPs. Values within this range indicate moderate impacts to project costs are expected, a strong possibility for project delays, and a need to use mitigation measures to resolve challenges. The alternative is not expected to be resilient or flexible to changing conditions over time and may require more work in the future. Values within this range indicate that the alternative is constructible, uses a blend of proven and innovative strategies for risk mitigation, has been applied to other project sites with success, and has moderate uncertainty. Land is available and suitable for equipment staging and/or sediment processing with major engineering and design support and costs. There is a moderate probability of project delay as materials and equipment for this alternative are available, and there are no long lead items. Results of dewatering strategy will be effective with high engineering support and cost. Transport to a final disposal area is achievable with interim storage. Regulatory acceptance is achievable but challenging.

1-5: Not recommended. Values within this range indicate that this alternative has several engineering and design challenges that could be mitigated with engineering and BMPs. Values within this range indicate that impacts to project costs are expected as well as a strong possibility for project delays and a need to use mitigation measures to resolve challenges. The alternative or criterion is meant to be a temporary fix and should not be considered a permanent solution. Values within this range indicate that the alternative is constructible, uses a blend of proven and innovative strategies for risk mitigation, has been applied to a few project sites with success, and has moderate uncertainty. Footprint required is not available. The space is suitable for equipment staging and/or sediment processing with major engineering and design support and costs. There is a moderate probability of project delay as materials and equipment for this alternative are available, and there are no long lead items. The dewatering strategy is not effective/existent and transport to final disposal area is not accounted for. Regulatory Acceptance is questionable.

8.2 Scoring Rationale

Table 8-1 Scoring Rationale provides a summary of the assessment components for each alternative:

Table 8-1 Scoring Rationale

Alternative	Assessment Component			
	Level of Service (LOS) Performance	Offsite Impacts	Engineer's Opinion of Probable Cost	Permit Issues, Mitigation Requirements, and Feasibility
Alternative 1 - Channel Improvement (Berms / Floodwalls)	25-Year	Offsite Structures Affected: 2.33-Yr = +8 10-Yr = +7 25-Yr = +11 100-Yr = +4	$16.8M	Both federal and state permits required for work within surface water. Impacts to Wetland 12 and Wetland 13 would require mitigation. USACE gives preference to purchase of mitigation bank credits. Amount of impact will determine type of USACE permit; Individual permit from USACE which will prolong permitting timeframes.
Alternative 2 - Channel Improvement (Floodwalls)	25-Year	Offsite Structures Affected: 2.33-Yr = +1 10-Yr = +4 25-Yr = -19 100-Yr = +5	$20.2M	Both federal and state permits required for work within surface water. Impacts to wetland 12 and Wetland 13 would require mitigation. USACE gives preference to purchase of mitigation bank credits. Amount of impact will determine type of USACE permit; Individual permit from USACE which will prolong permitting timeframes.
Alternative 3 - Backpumping to Lake Bonnet	10-Year / 25-Year	Offsite Structures Affected: 2.33-Yr = -1 10-Yr = -7 25-Yr = -1 100-Yr = -16	$38.8M	Both federal and state permits required for work within surface water. Impacts to Wetland 14 and lake littoral zone would require mitigation. Will need further analysis to demonstrate that lower lake level will not adversely impact wetlands. Long-term maintenance and monitoring for littoral zone restoration. Dredging impacts to Wetland 8 will require mitigation. USACE gives preference to purchase of mitigation bank credits.
Alternative 4 - Detention (Pond / Underground Storage)	None	Offsite Structures Affected: 2.33-Yr = -15 10-Yr = -17 25-Yr = -6 100-Yr = -13	$39.7M	Both federal and state permits required for work within surface water. Impacts to Wetland 12 and Wetland 13 would require mitigation. USACE gives preference to purchase of mitigation bank credits. Amount of impact will determine type of USACE permit; Individual permit from USACE which will prolong permitting timeframes.

Table 8-2 Scoring Rationale, Continued

Alternative	Assessment Component		
	FEMA Compliance	Property / ROW Requirements	Constructability
Alternative 1 - Channel Improvement (Berms / Floodwalls)	Yes	Requires permission from private properties to construct the project. Temporary and permanent easements are required for construction, and long-term maintenance and operation, respectively.	Construction should be performed during the dry season especially dewatering activity. Maintenance of pumping facilities is an additional expense to the City.
Alternative 2 - Channel Improvement (Floodwalls)	Yes	Requires permission from private properties to construct the project. Temporary and permanent easements are required for construction, and long-term maintenance and operation, respectively.	Construction should be performed during the dry season especially dewatering activity. Maintenance of pumping facilities is an additional expense to the City.
Alternative 3 - Backpumping to Lake Bonnet	Yes	Requires permission from private properties to construct the project. Temporary and permanent easements are required for construction, and long-term maintenance and operation, respectively.	Construction should be performed during the dry season especially dewatering activity. Maintenance of pumping facilities is an additional expense to the City.
Alternative 4 - Detention (Pond / Underground Storage)	Yes	Requires permission from private properties and school to construct the project. Temporary and permanent easements are required for construction, and long-term maintenance and operation, respectively.	Construction should be performed during the dry season especially dewatering activity. Maintenance of pumping facilities is an additional expense to the City.

8.3 Decision Matrix

Table 8-3 Decision Matrix provides the score breakdown of each of the alternative assessment for each alternative.

Table 8-2 Decision Matrix

	Assessment Component							
Alternative	*** Level of Service (LOS) Performance**	**Offsite Impacts**	**Engineer's Opinion of Probable Cost**	**Permit Issues, Mitigation Requirements& Feasibility**	**FEMA Compliance**	**Property / ROW Requirements**	**Constructability**	**Total**
Alternative 1 - Channel Improvement (Berms / Floodwalls)	8	8	12	13	15	10	8	74
Alternative 2 - Channel Improvement (Floodwalls)	8	8	11	13	15	10	8	73
Alternative 3 - Backpumping to Lake Bonnet	15	16	10	7	15	10	10	83
Alternative 4 - Detention (Pond / Underground Storage)	5	12	2	13	15	8	8	63

* Level of Service (LOS) Performance does not consider one foot of freeboard above flood water surface elevations.

9. Conclusions

9.1 Alternatives Evaluation

9.1.1 Performance/Level of Service (LOS)/Effectiveness at Mitigation

The estimated Level of Service for the proposed alternatives is presented in **Table 8-3**. These estimates are based on the number of structures that are reasonably removed from the risk of flooding by implementation of the particular alternative. This feasibility assessment component provides an indication of how efficient each alternative is at meeting flood risk reduction goals and provides for a direct comparison of the benefits of each alternative. Alternatives 1 and 2 provide a similar level of service up to the 25-year flood event. Alternative 3 provides a level of service up to the 10-year flood event. Alternative 4 is assumed to not provide a level of service due to the relatively low flood risk reduction even for the most frequent event studied (2.33-yr event,17 of 43 structures).

Table 9-1 Level of Service Estimate - Affected Structure Comparison (Project Reach) (1)

<table>
<tr><th rowspan="2">Event Frequency</th><th rowspan="2">Existing Count (2)</th><th colspan="2">Alternative 1 (6)</th><th colspan="2">Alternative 2 (6)</th><th colspan="4">Alternative 3 (7)</th><th colspan="2">Alternative 4 (8)</th></tr>
<tr><th>Count (3)</th><th>Improvement (%)</th><th>Count (3)</th><th>Improvement (%)</th><th colspan="2">Count (3)</th><th colspan="2">Improvement (%)</th><th>Count (3)</th><th>Improvement (%)</th></tr>
<tr><td>100-year</td><td>220</td><td>220</td><td>0%</td><td>220</td><td>0%</td><td colspan="2">132</td><td colspan="2">40%</td><td>177</td><td>20%</td></tr>
<tr><td>25-year</td><td>154</td><td>1</td><td>100%</td><td>1</td><td>99%</td><td>41(4)</td><td>19(5)</td><td>73%(a)</td><td>88%(b)</td><td>113</td><td>27%</td></tr>
<tr><td>10-year</td><td>108</td><td>1</td><td>100%</td><td>1</td><td>99%</td><td colspan="2">6</td><td colspan="2">94%</td><td>76</td><td>30%</td></tr>
<tr><td>2.33-year</td><td>43</td><td>1</td><td>100%</td><td>1</td><td>98%</td><td colspan="2">1</td><td colspan="2">98%</td><td>26</td><td>40%</td></tr>
</table>

Notes:

(1) Structures (homes and other facilities used by residents) located east of N. Wabash Ave. Structure count based on its location within a particular floodplain boundary and without regard to its finished floor elevation.

(2) Number of structures within floodplain boundary under existing conditions.

(3) Number of structures within floodplain boundary under proposed conditions.

(4) As proposed, see Section 5.3.

(5) With potential minor Lake Bonnet Drain channel side slope regrading/ repairs.

(6) Estimated Level of Service 25-year flood frequency. For 2.33-yr through 25-yr events, the one (1) remaining structure represents a conservative estimate, indicated by only minor adjacent yard inundation.

(7) Estimated Level of Service 10-year flood frequency. The 10-yr event's six (6) remaining structures and the 2.33-yr event's one (1) remaining structure represent a conservative estimate indicated by only minor adjacent yard inundation.

(8) Based upon the limited number of structures experiencing flood risk reduction, no Level of Service was met within the flood frequencies considered.

9.1.2 Offsite Impacts (Flood Levels and Flows)

The Offsite Impact feasibility assessment component was developed to provide a direct comparison of potential effects resulting from the implementation of a particular alternative. The offsite impacts assessment consists of two elements including a comparison of affected structures (existing vs proposed) and changes in stormwater flood elevations and flow rates. **Table 8-4** presents a comparison of affected structures within existing floodplain boundaries versus the number of structures within the floodplain boundaries created by the particular alternative. As illustrated implementation of Alternative 1 would act to increase the number of structures within the estimated floodplain boundaries (downstream of N. Wabash Ave.) for all event frequencies. The number of additional affected structures ranges from four to eleven for the 100-year and 25-year events, respectively. Similarly, implementation of Alternative 2 would act to increase the number of structures within the estimated floodplain boundaries for three of the four storm events. Implementation of either Alternative 3 or 4 would act to decrease the number of structures within their respective floodplain boundaries. This feasibility assessment component provides an indication of the level of difficulty in stormwater and floodplain permitting for each alternative, with the potential of being a fatal flaw for alternatives that increase the number of impacted structures.

Table 9-2 Offsite Impacts - Affected Structure Comparison (1)

Event Frequency	Existing Count (2)	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Count (3)	Change (%)(4)	Count (3)	Change (%)(4)	Count (3)	Change (%)(4)	Count (3)	Change (%)(4)
100-year	144	148	3%	149	3%	128	-11%	129	-10%
25-year	88	99	13%	69	-22%	87	-1%	82	-7%
+10-year	66	73	11%	70	6%	59	-11%	49	-26%
2.33-year	32	40	25%	33	3%	31	-3%	19	-41%

Notes:

(1) Structures (homes and other facilities used by residents) located west of N. Wabash Ave. Structure count based on its location within a particular floodplain boundary and without regard to its finished floor elevation.

(2) Number of structures within floodplain boundary under present conditions.

(3) Number of structures within floodplain boundary under proposed conditions.

(4) Positive values reflect an increase in the number of affected structures, and negative values reflect a decrease in the number of affected structures.

Changes in stormwater flood elevations and flow rates in downstream areas (west of N. Wabash Ave.) provide an indication of the level of difficulty in stormwater and floodplain permitting for each alternative, with the potential of being a fatal flaw for alternatives that increase these values at a significant number of locations. **Table 8-5** provides a summary of the number of locations that experience increased flood elevations, flow rates, or both at the same location. As illustrated, implementation of either Alternatives 1, 2, and 4 would produce a substantial number of locations experiencing increased flood elevations and flow rates. It is important to note that flood elevation increases are more significant than flow rate increases such that the flood elevation will increase the extent of the floodplain boundary, whereas flow rate increases will not. Alternative 3 produces only a limited number of increased flow rate locations, which are considered insignificant as they do not produce an increase in flood elevation anywhere in the downstream network.

Table 9-3 Offsite Impacts - Change in Model Flood Elevation and Flow Rate (1)

	Alternative 1				Alternative 2			
Event Frequency	**Stg +, Flow +**	**Stg +, Flow 0**	**Stg 0, Flow +**	**Stg 0, Flow 0**	**Stg +, Flow +**	**Stg +, Flow 0**	**Stg 0, Flow +**	**Stg 0, Flow 0**
100-year	17	3	17	51	16	4	15	53
25-year	16	2	17	53	16	2	16	54
10-year	17	0	21	50	17	0	21	50
2.33-year	17	1	19	51	17	0	18	53

	Alternative 3				Alternative 4			
Event Frequency	**Stg +, Flow +**	**Stg +, Flow 0**	**Stg 0, Flow +**	**Stg 0, Flow 0**	**Stg +, Flow +**	**Stg +, Flow 0**	**Stg 0, Flow +**	**Stg 0, Flow 0**
100-year	0	0	6	81	0	17	7	64
25-year	0	0	12	75	0	9	2	77
10-year	0	0	4	83	2	37	0	49
2.33-year	0	0	0	87	5	40	1	42

Notes:

(1) Indicates the number of model locations where flood elevation and flow rate change relative to existing conditions for areas west of N. Wabash Ave.

Based on feasibility assessment and a comparison of scores in the Decision Matrix (**Table 8-2**), Alternative 3 – Backpumping to Lake Bonnet is recommended over other alternatives. It is important to note that Lake Bonnet may not have the storage capacity to mitigate flooding if there is a back-to-back storm events where there is no opportunity for the water in the lake from the previous storm to be discharged/emptied out to provide the storage volume necessary for the next storm.

9.1.3 Engineer’s Opinion of Probable Cost (EOPC)

The improvements for Alternatives 1 and 2 are similar except for the type of floodwalls proposed. Alternative 1 proposes a combination of berms and sheet pile, whereas Alternative 2 proposes sheet pile only. The construction cost for both the alternatives are similar except that Alternative 2 proposes more sheet pile than Alternative 1, which is the main reason for the increase in cost. As a result, the estimate for Alternative 2 is $20.2M, which came in higher than Alternative 1 by $3.4M.

The cost estimate for Alternative 4 is $39.7M, which is the highest when compared to other Alternatives and exceeds the available budget of $33.6M. The cost is primarily driven by the material and the construction of the detention pond and underground detention vaults. The Alternative 4 is the least preferred option due to the high cost and yields the poorest result in mitigating flooding.

The cost estimate for Alternative 3 is $20.3M. The alternative scored the highest in the decision matrix given the cost and its performance to relief flooding. Similar to all the alternatives, the long-term operation and maintenance should be considered. There are one pump station, two sump pumps stations, and the storm drainage system that will convey stormwater to the sump pumps that will require maintenance. There will be routine maintenance such as removing debris and sediment within Lake Bonnet Drain and maintaining the pump facilities such as exercising the generators and pumps and maintaining the access path leading to the sump pumps. The City of Lakeland will need in-house staff or outside consultant with technical expertise to diagnose, repair, operate and maintain the sump pumps. The pump station and sump pumps will be an added expense and should be factored into the City’s budget prior to selecting the alternative.

9.1.4 Permit Issues, Mitigation Requirements, and Feasibility

All alternatives considered would require authorization from federal, state, and local regulatory agencies. Regulatory agencies evaluate impacts based on the amount of direct and indirect impacts to natural resources, in particular to wetlands and surface waters. As the number and/or significance of project impact(s) grows, so may the overall review time and/or level of studies/documentation necessary to obtain an authorization.

A USACE Standard permit (also known as an Individual Permit), SWFWMD Individual ERP, and City of Lakeland tree permit are anticipated to be required for all alternatives.

In addition, the selected alternative is required to comply with HUD's NEPA process. HUD's decision-making process provides for the delegation of environmental review to a local responsible entity (City of Lakeland) applicable to this proposed action and establishes NEPA procedural requirements. As part of the NEPA process, the public will be provided an opportunity for review and comment on those evaluations. Two major purposes of the environmental review process are better-informed decisions and stakeholder involvement. AECOM will coordinate with the city to confirm roles and responsibilities.

9.1.5 FEMA Compliance

Implementation of any of the alternatives will require acquisition of a permit through FEMA to document potential changes to effective floodplain boundaries and to demonstrate no adverse impacts to the designated floodway. This will include all onsite and offsite areas with designated boundaries. Offsite effective boundaries extend downstream to Chestnut Road. It is most likely that a Letter of Map Revision (LOMR) application will need to be filed with FEMA.

Compliance with FEMA regulations regarding floodplain and floodway boundaries requires the demonstration of no adverse impacts. Technical documentation based on the results of hydraulic model studies will be submitted with the LOMR application to demonstrate compliance with FEMA requirements.

Given that the proposed alternatives are permittable and are essentially equal with respect to FEMA regulatory requirements, no further assessments are required at this time. Detailed modeling will be conducted in support of FEMA approval for the selected alternative.

9.1.6 Property/ Right-Of-Way (ROW) Requirements

The Lake Bonnet Drain along the Project Reach consists of private properties owned by separate entities, where improvements will occur. Permission is required from all private properties affected to perform the flood mitigation project for the alternatives.

Temporary and permanent easements on the private properties will be dedicated to the City of Lakeland. Temporary easements will be required for construction access and staging, and permanent easements will be required for access, maintenance and operation. The permanent easements will allow the City of Lakeland to perform routine inspection and maintenance of the Lake Bonnet Drain and pumping facilities installed for the project. Long-term maintenance to be performed by the City of Lakeland would include removing debris and sediment from within the Lake Bonnet Drain, repairing berm and floodwall, and maintaining the pump facilities such as exercising the generators and pumps.

Obtaining concurrence from all the affected owners to perform the improvements is critical to the success of the Project.

9.1.7 Constructability

Due to proximity of existing structures, the project would require additional security personnel and security equipment such as fences, cameras and lighting around the construction site for public safety. Also, maintenance of traffic control personnel and equipment is required during the replacement of the bridge/culvert crossings.

All the alternatives require dredging and regrading of the Lake Bonnet Drain, whereby the channel will have to be dewatered first. Dewatering the channel could be accomplished by closing the sluice gates outlet control structure for Lake Bonnet. If closing the sluice gates outlet control structure for Lake Bonnet is not possible, the other option for dewatering would involve the installation of a temporary cofferdam and a by-pass pump to divert water away from the construction area.

Construction staging, access, and the sequence of construction will have to be vetted out during the design phase and simultaneously reaching out to the affected property owners to secure written consent to allow construction activities on their property. The success of the project is dependent on the cooperation of the private properties.

The awarded contractor for construction will have to work closely with the City and the design team to develop an executable plan of means and methods with consideration of the affected properties prior to breaking ground for construction.

The timing of construction is also critical to the success of the project. Therefore, procuring the construction contractor in advance of the construction schedule is necessary to ensure the contractor has adequate time to get ready to initiate construction at the beginning of the dry season.

These factors could result in delays and significantly increase the cost of construction.

9.2 Other Considerations

The proposed sump pumps and pump station are located in the flood zone. In light of recent hurricane events, low-lying areas that rely on pumps to pump floodwater were flooded due to the loss of electricity, and fuel for backup power was not readily available. To prevent the critical equipment such as the generator, fuel tank, and pump controls for the pumps from failing, this equipment will have to be raised above flood elevations.

The access leading to the pumping facilities will have to be raised to above flood elevations to allow the City of Lakeland personnel to access the pumping facilities during flooding events. The maintenance access roads will need to be designed to manage the vehicle load and geometry of utility vehicles towing equipment such as generator and fuel delivery tank. Providing the access could be a challenge with the proximity of existing structures.

Similar to all the alternatives, the long-term operation and maintenance should be considered. There are pumps, and the storm drainage system to convey stormwater to the sump pumps will require maintenance. There will be routine maintenance, such as removing debris and sediment within Lake Bonnet Drain, and maintaining the pump facilities, such as exercising the generators and pump and maintaining the access path leading to the sump pumps. Additionally, a nearby location will have to be identified to store spare parts for the pump equipment.

The City of Lakeland will need in-house staff or outside consultant with technical expertise to diagnose, repair, operate and maintain the sump pumps. The sump pumps are an added expense and should be factored into the City’s budget prior to selecting the alternative.

9.2.1 Preliminary Assessment: Proposed Culvert Beneath Lake Bonnet Drain

During the development of the alternatives presented in the feasibility study, AECOM also looked beyond the flood-prone areas of Sterling Homes and May Manor along the Lake Bonnet Drain in search of other possibilities to mitigate the flooding. This preliminary assessment was not presented as an alternative, considering that the proposed flood mitigation improvements extend downstream of North Wabash Avenue along the Lake Bonnet Drain. In addition, the proposed improvements will require concurrence from a significant number of private property owners, which could be challenging.

Under the existing condition, the portion of Lake Bonnet Drain from North Wabash Avenue to Lake Charles has a relatively small cross-sectional channel area, which creates a choke point to the flow of stormwater. The constriction impedes the flood water from flowing through, resulting in water backing up and flooding Sterling Mobile Home Park and May Manor. A quick assessment was performed to eliminate the choke point simply by increasing the cross-sectional area of that portion of the Lake Bonnet Drain to improve the flow conveyance. A 15-foot by 6-foot concrete box culvert approximately a mile in length from Wabash Avenue to Lake Charles is proposed beneath the Lake Bonnet Drain to improve flow conveyance by means of gravity. Drainage inlets are also proposed at the bottom of the Lake Bonnet Drain channel spaced every 200 feet to intercept and convey flood water into the culvert.

The proposed culvert resulted in a reduction of flood water elevations at May Manor and Sterling Homes for the mean annual rainfall, 10-year, 25-year, and 100-year storm events when compared to the existing condition. However, the improved flow conveyance increased the flow downstream and consequently increased the flood water surface elevations downstream of the proposed culvert.

The increase in flood water surface elevations downstream of the proposed culvert could be mitigated utilizing the ponds at Lone Palm golf course. A detailed analysis will be necessary to determine if the dredging of the ponds is necessary to increase the storage volume to reduce the flood water surface elevations downstream.

The installation of the proposed box culvert would require the six existing culvert/bridge crossings between Wabash Avenue and Lake Charles to be removed and replaced-in-kind; and the weirs at the golf course and Sterling Homes to be removed. To accomplish the culvert installation, the existing culvert/bridge crossings will have to be demolished and constructed in sections while maintaining traffic movement, and the existing utilities at the crossings will have to be temporarily rerouted. Sheeting along the Lake Bonnet Drain banks is necessary for the trench excavation of the culvert due to the proximity of existing homes and structures. The sheet pile will be cut to a foot below final grade and abandoned in place after the installation of the culvert.

The EOPC for the proposed culvert is $55.7M. The cost is driven by the work related to the culvert installation, such as dewatering of both surface water and groundwater, the depth of excavation, sheeting, and the material and labor of the concrete box culvert. Furthermore, the work to replace the existing culvert/bridge crossings and the temporary rerouting of utilities increases the construction cost.

There is a potential to reduce the construction cost by eliminating the concrete box culvert and deepening the Lake Bonnet Drain channel with sheet pile installed at the banks. Additional assessment is necessary to determine the viability of the approach.

It is important to note that the proposed culvert installation, like the alternatives presented in this report, requires permission from private properties along the Lake Bonnet Drain to construct. The proposed culvert installation will involve more private properties compared to the other alternatives. Temporary easement for access and staging for construction and permanent easement for maintenance and access shall be established on private properties where the work would occur and dedicated to the City of Lakeland.

Permission will be required from Lone Palm golf course to replace the golf cart path bridges, remove the weir structure and dredging the ponds. The Lone Palm Golf Course and the City of Lakeland shall agree to a party that will be responsible for the long-term maintenance and operation of the ponds' functionality for flood mitigation.

Refer to **Appendix E** for the plans and figures, engineer's opinion of probable cost, and offsite impact figures prepared for the preliminary assessment.

9.3 Preferred Alternative Selection

Based on the results of the study, the City of Lakeland selected Alternative 3 as the preferred flood mitigation strategy. Alternative 3 involves the installation of a pump station just downstream of the Lake Bonnet outlet control structure to backpump stormwater from the Lake Bonnet Drain into the lake. This approach includes dredging a 3,210-foot segment of the Lake Bonnet Drain channel with a negative slope to collect stormwater, which will then be pumped across North Brunnell Parkway via a force main. Channel improvements within the Lake Bonnet Drain involve regrading would include floodwalls installed at key transitions, and additional sump pump stations will handle local drainage in low-lying areas. The approach also includes dredging Lake Bonnet to lower the current water level elevation to increase the hydraulic storage volume of the lake.

The analysis of Alternative 3 indicates the following number of structures will be removed from the risk of flooding within the Project Reach for the various storm events:

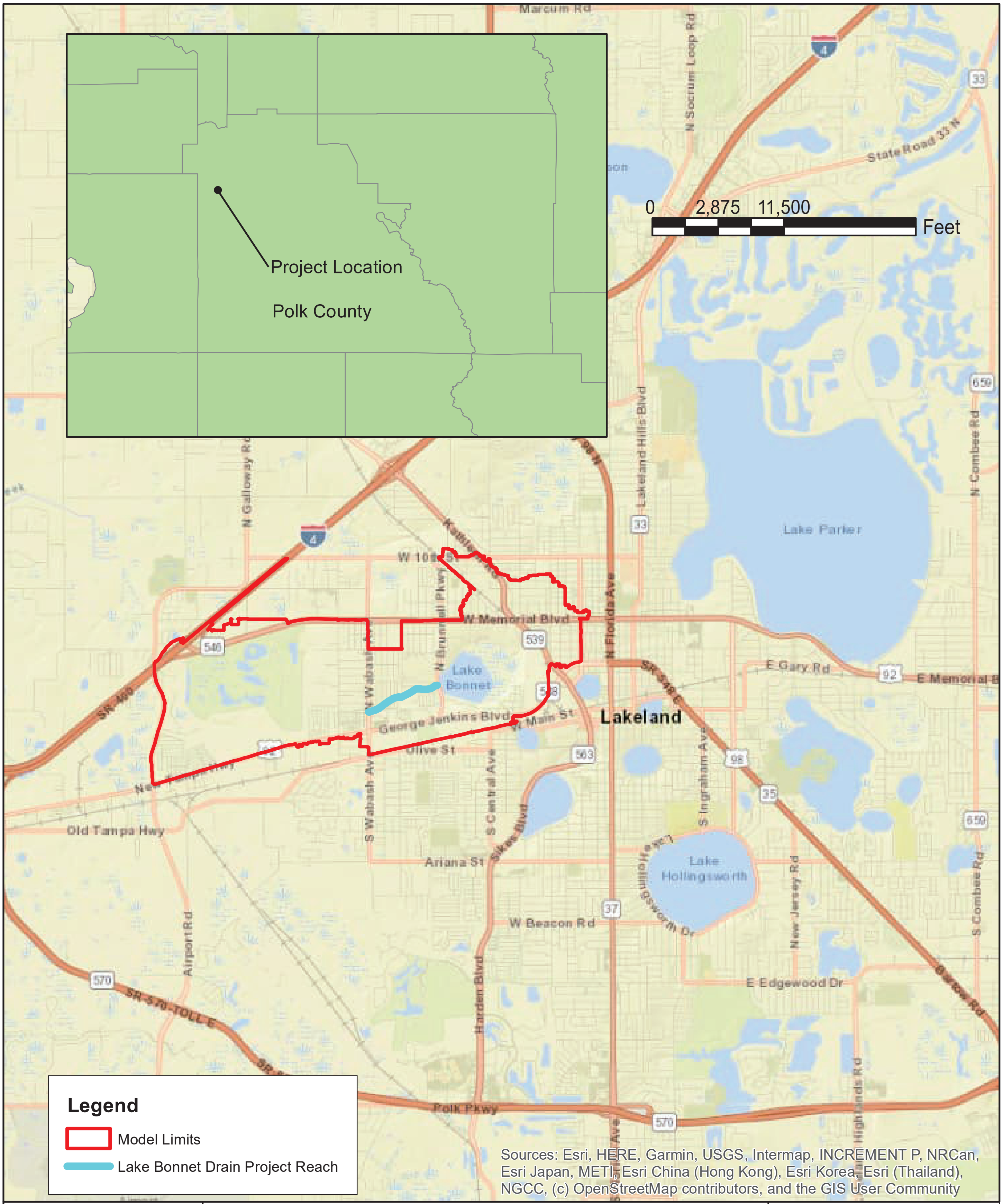
- 2.33-year storm: 42 of 43 structures removed
- 10-year storm: 102 of 108 structures removed
- 25-year storm: 113 of 154 structures removed
- 100-year storm: 88 of 220 structures removed

Results also indicate that there is no increase in water surface elevations in Lake Bonnet Drain downstream of North Wabash Avenue compared to existing conditions. The backpumping to Lake Bonnet alternative will also reduce flooding duration within the study reach. It is important to note that Lake Bonnet may not have enough storage capacity to mitigate flooding during consecutive storm events if there is insufficient opportunity to discharge water from the previous storm, reducing storage for the next storm.

The long-term operation and maintenance should be considered and factored into the City's budget. There will be routine maintenance, such as removing debris and sediment within Lake Bonnet Drain and maintaining the pump facilities, such as exercising the generators and pumps maintaining the access path leading to the sump pumps. A location has to be identified to store spare parts for the pump equipment. The City of Lakeland will need in-house staff or an outside consultant with technical expertise to diagnose, repair, operate, and maintain the pumps.

The improvements for Alternative 3 will occur on Sterling Homes, May Manor, and other private properties adjacent to Lake Bonnet and within the North Brunnell Parkway right-of-way. Therefore, concurrence is required from the affected properties to successfully execute the flood mitigation project.

FIGURES



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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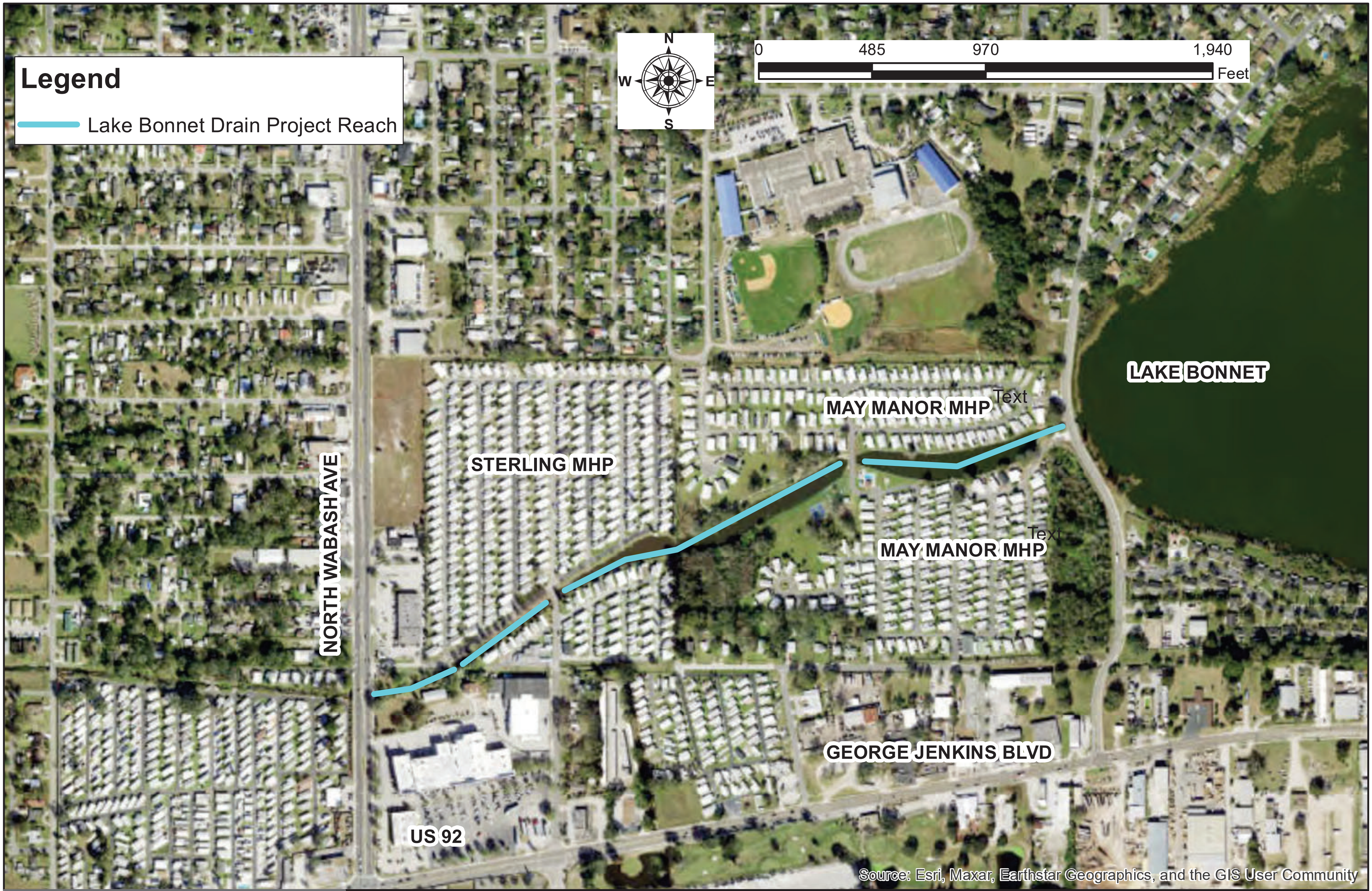
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

REGIONAL LOCATION MAP

FIGURE 1



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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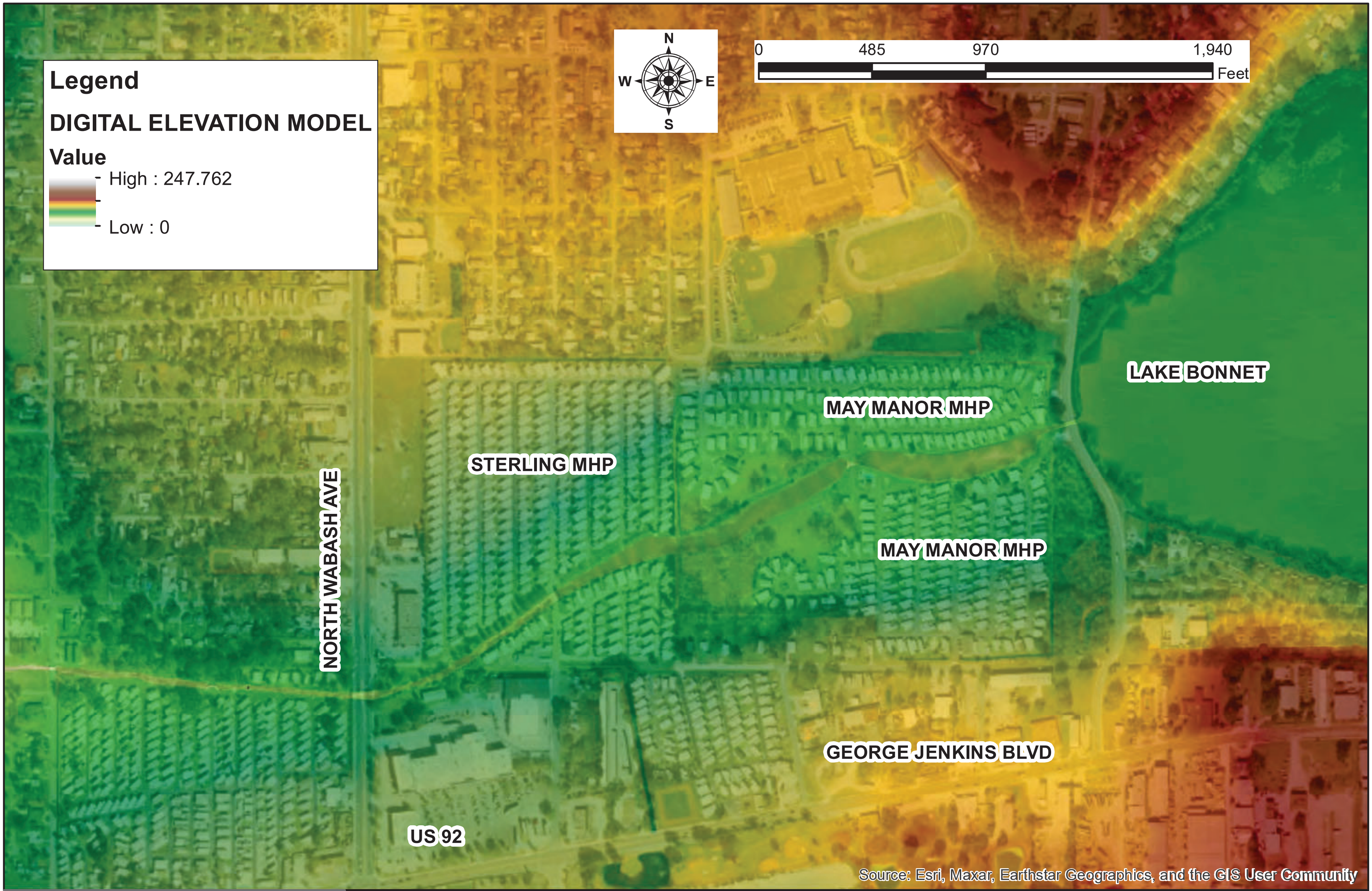
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION
PROJECT
CITY OF LAKELAND

PROJECT AREA
IDENTIFICATION MAP

FIGURE 2



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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LAKE BONNET DRAIN FLOOD HAZARD MITIGATION
PROJECT
CITY OF LAKELAND

PROJECT AREA
TOPOGRAPHIC MAP

FIGURE 3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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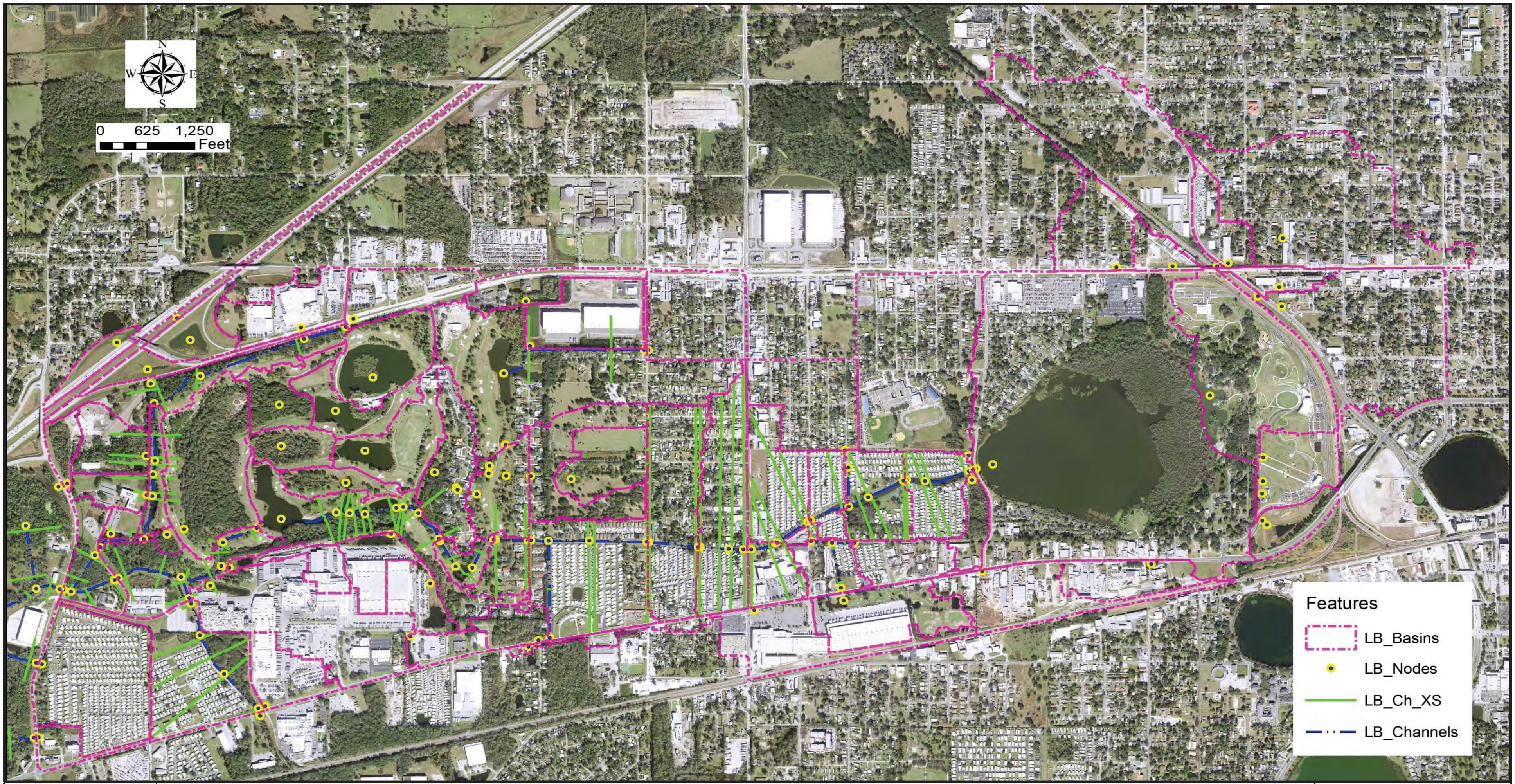
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

FEMA National Flood Hazard Layer Efffective FIS 12/22/2016

PROJECT AREA FEMA FLOOD HAZARD MAP

FIGURE 4



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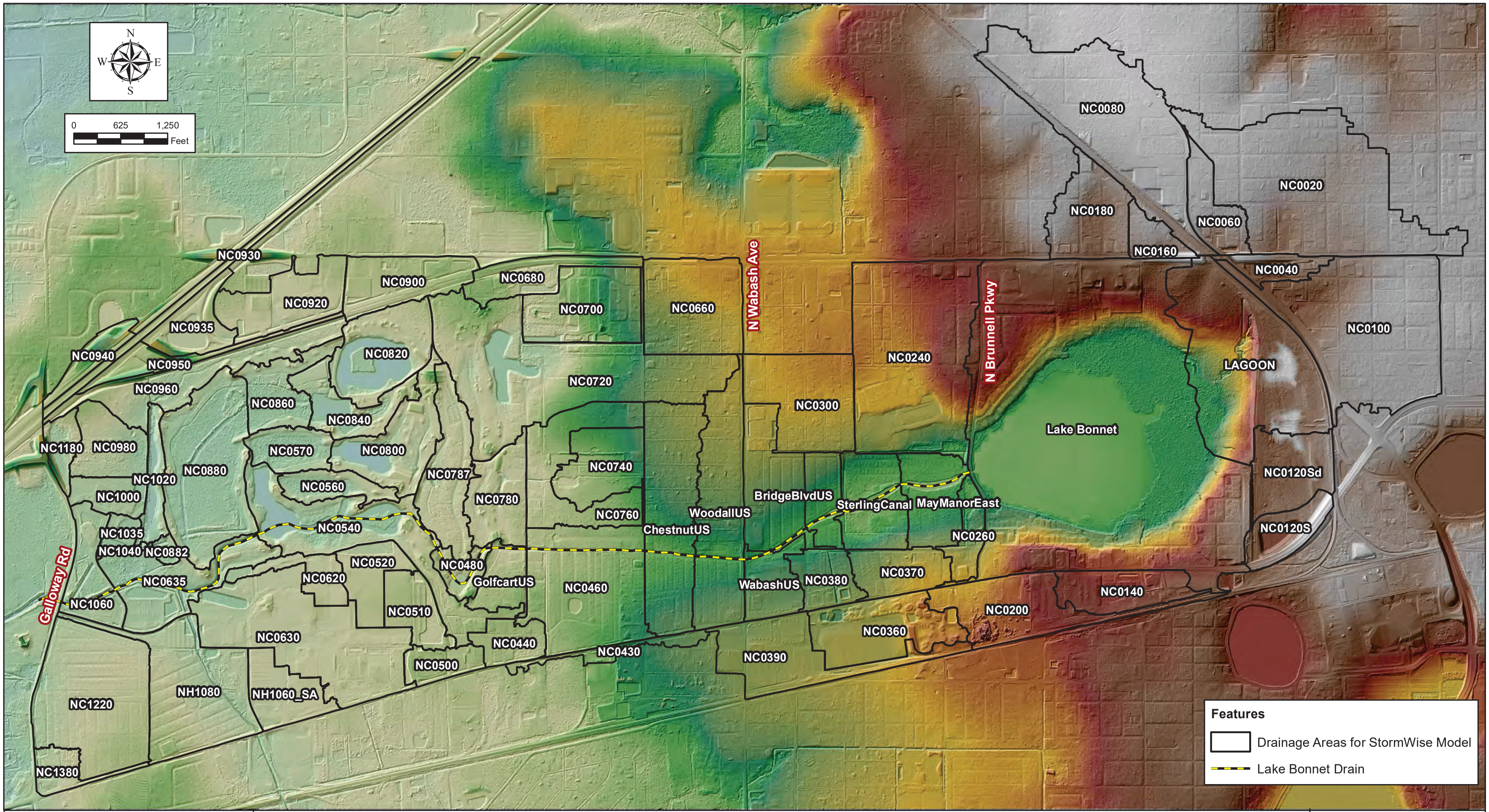
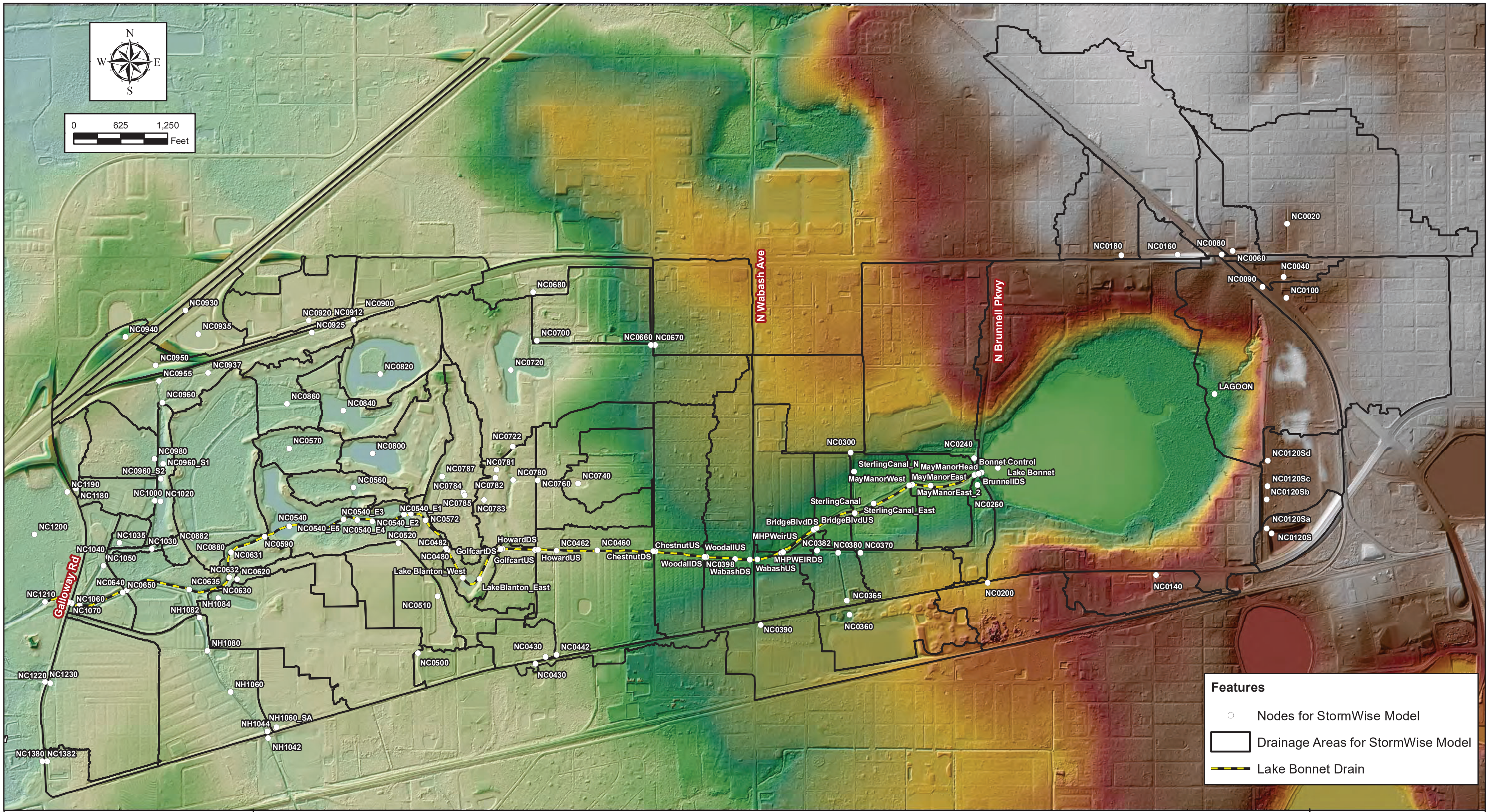
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
HYDROLOGIC MODEL DOMAIN

FIGURE
5



LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
HYDROLOGIC MODEL SCHEMATIC - SUBBASIN ELEMENTS

FIGURE
6



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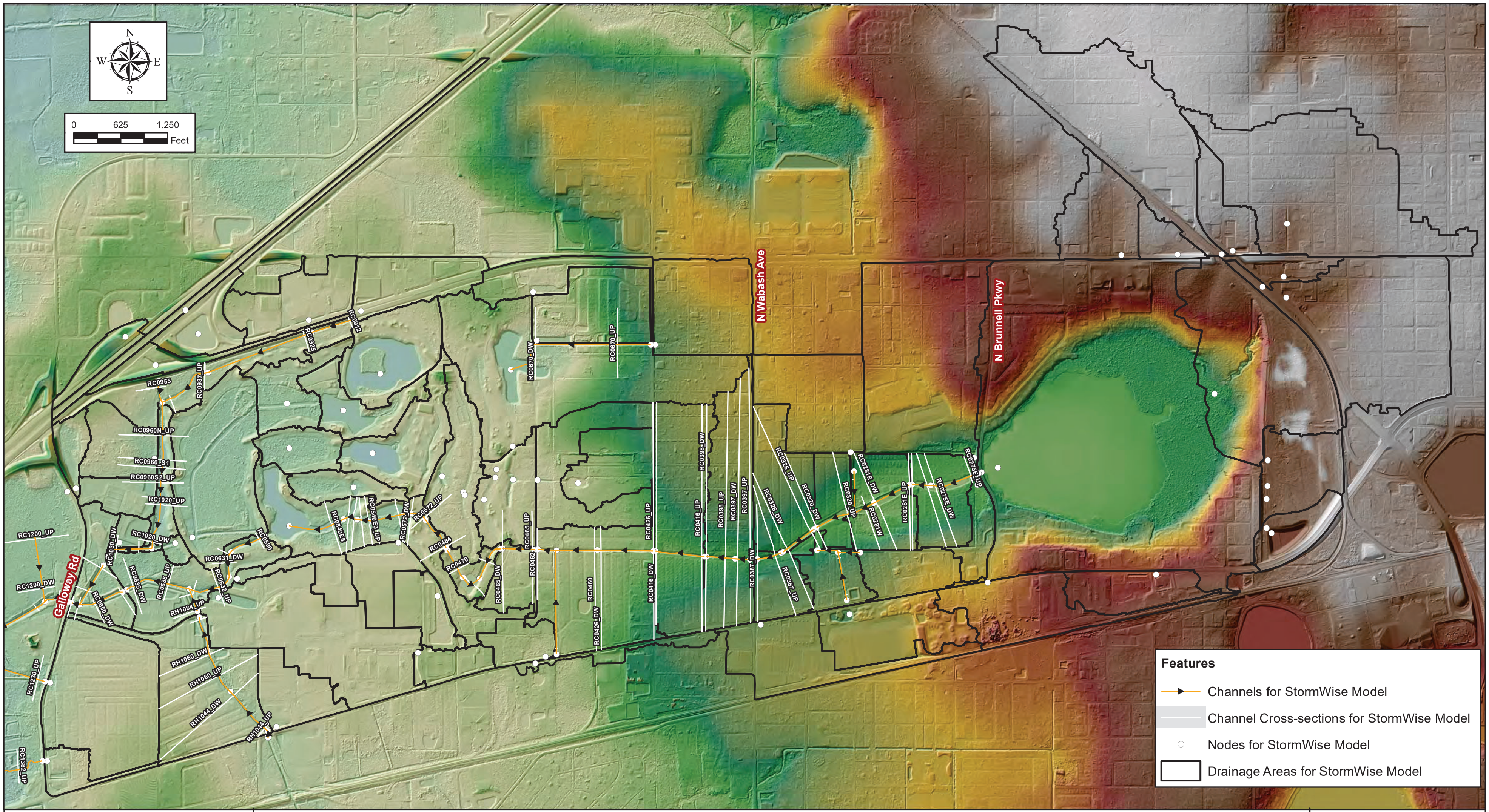
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
HYDROLOGIC MODEL SCHEMATIC - NODE ELEMENTS

FIGURE
7



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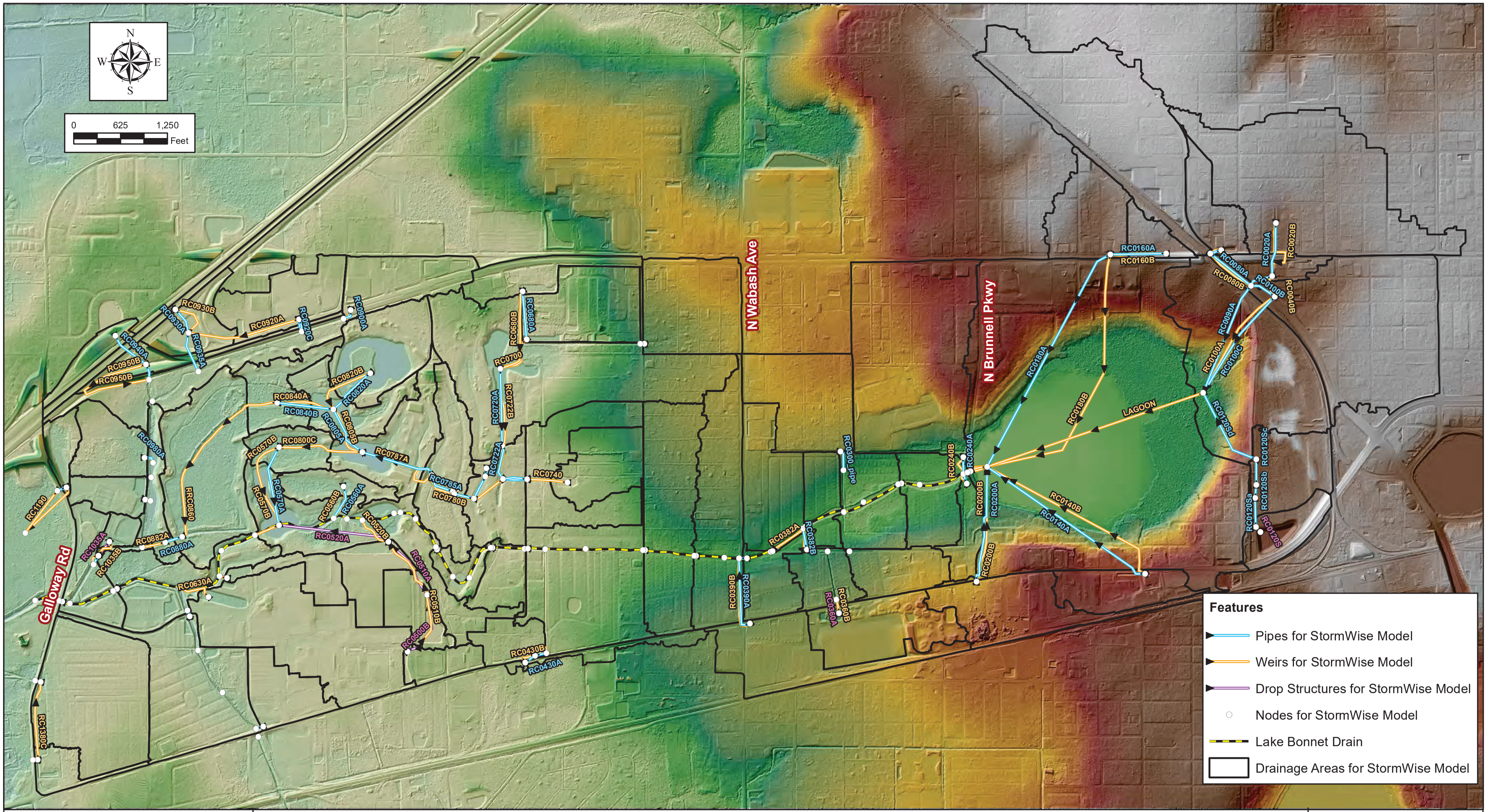
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
HYDROLOGIC MODEL SCHEMATIC - CHANNEL ELEMENTS

FIGURE
8



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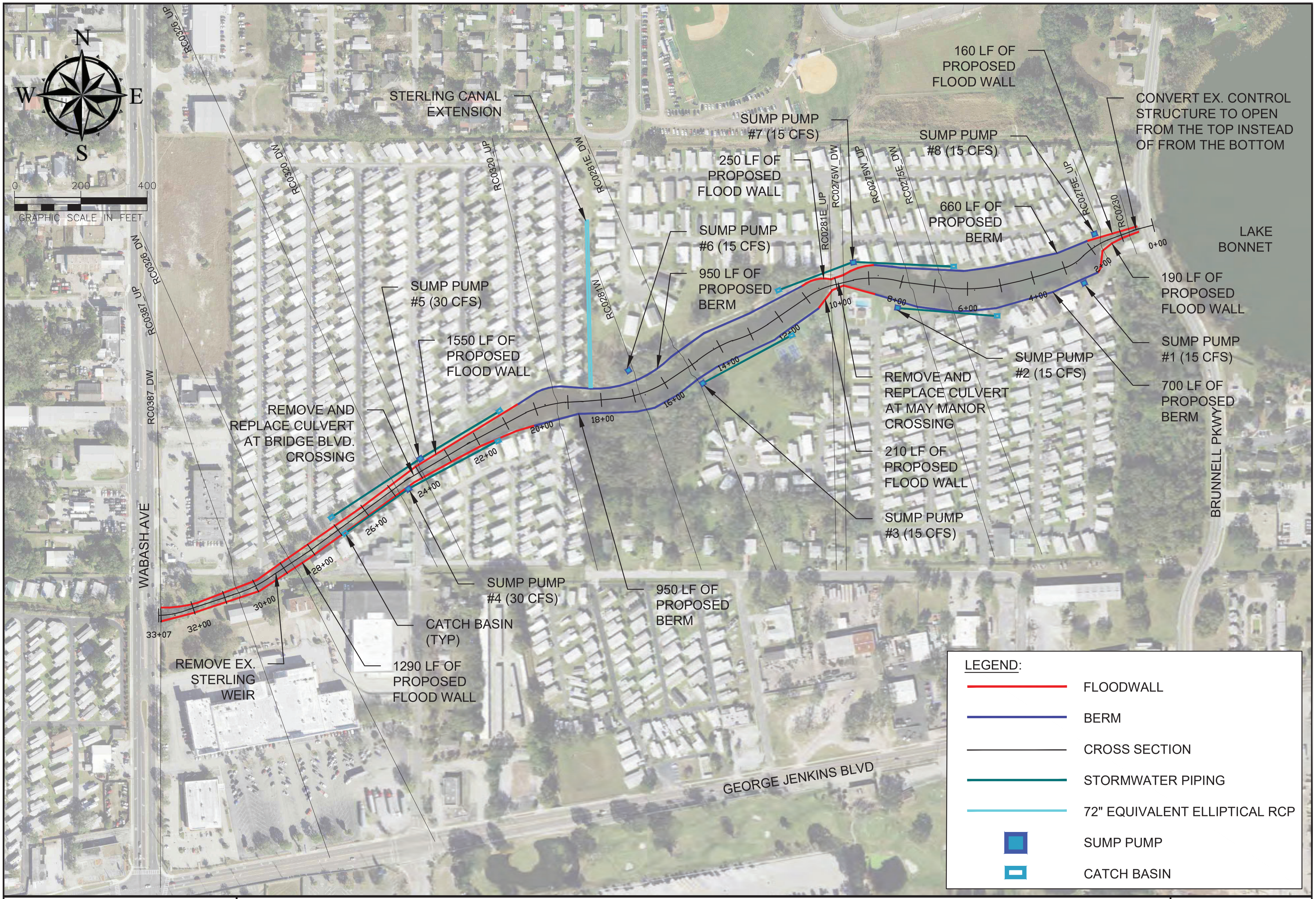
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
HYDROLOGIC MODEL SCHEMATIC - LINK ELEMENTS (EXCLUDING CHANNELS)

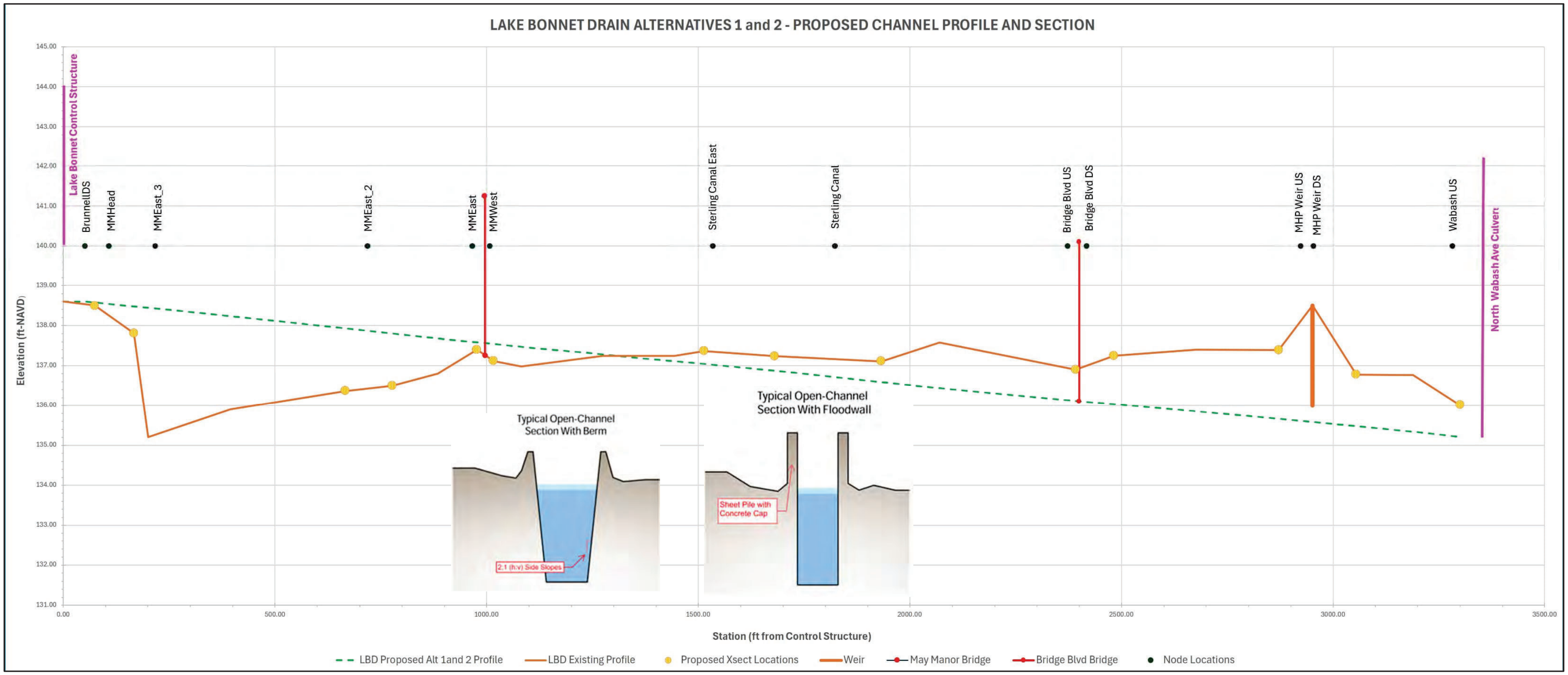
FIGURE
9



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 1 - CHANNEL IMPROVEMENT (BERMS / FLOODWALLS)

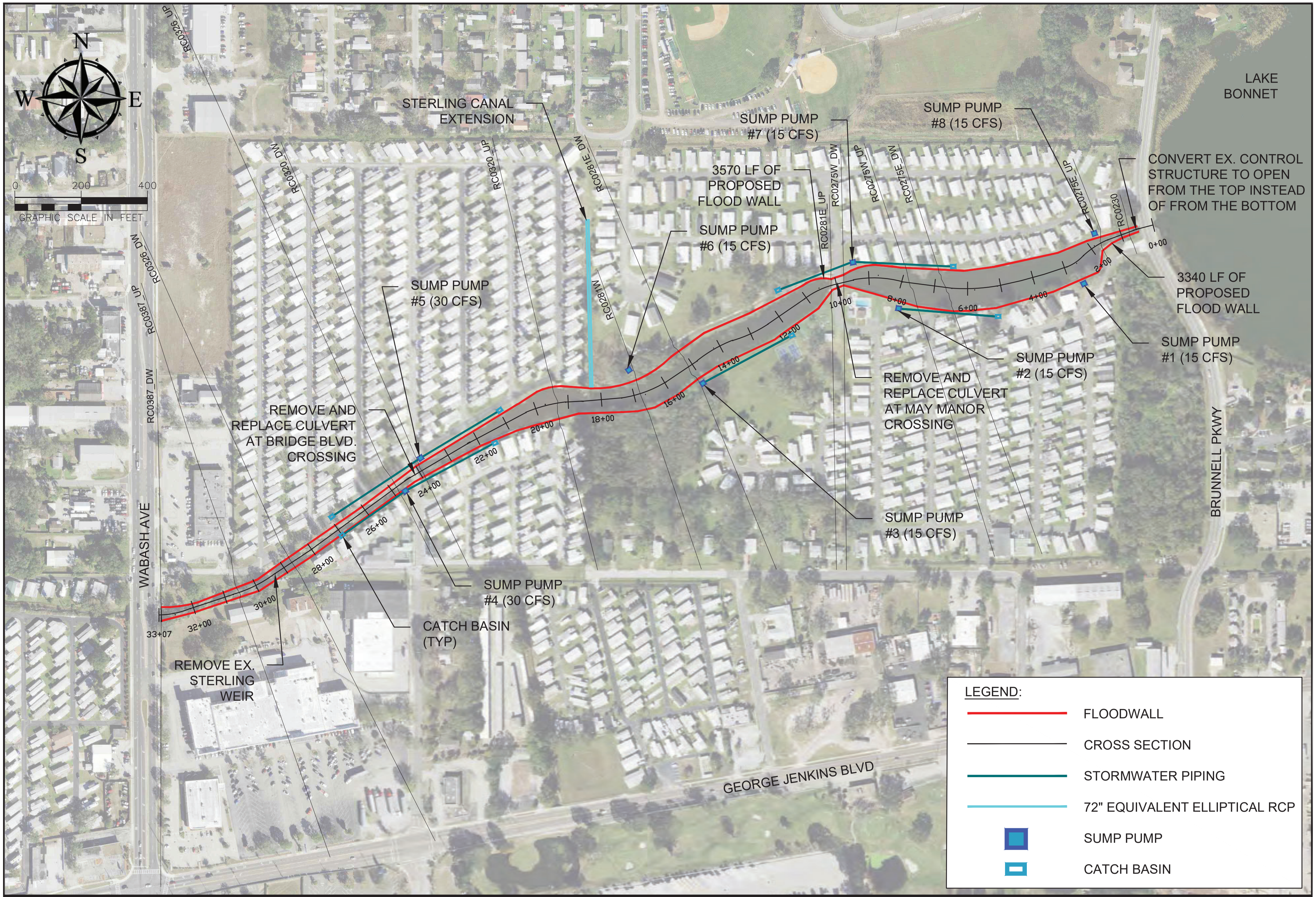
FIGURE 10


LAKE BONNET DRAIN ALTERNATIVES 1 and 2 - PROPOSED CHANNEL PROFILE AND SECTION

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVES 1 AND 2

PROPOSED CHANNEL PROFILE AND CROSS-SECTIONS

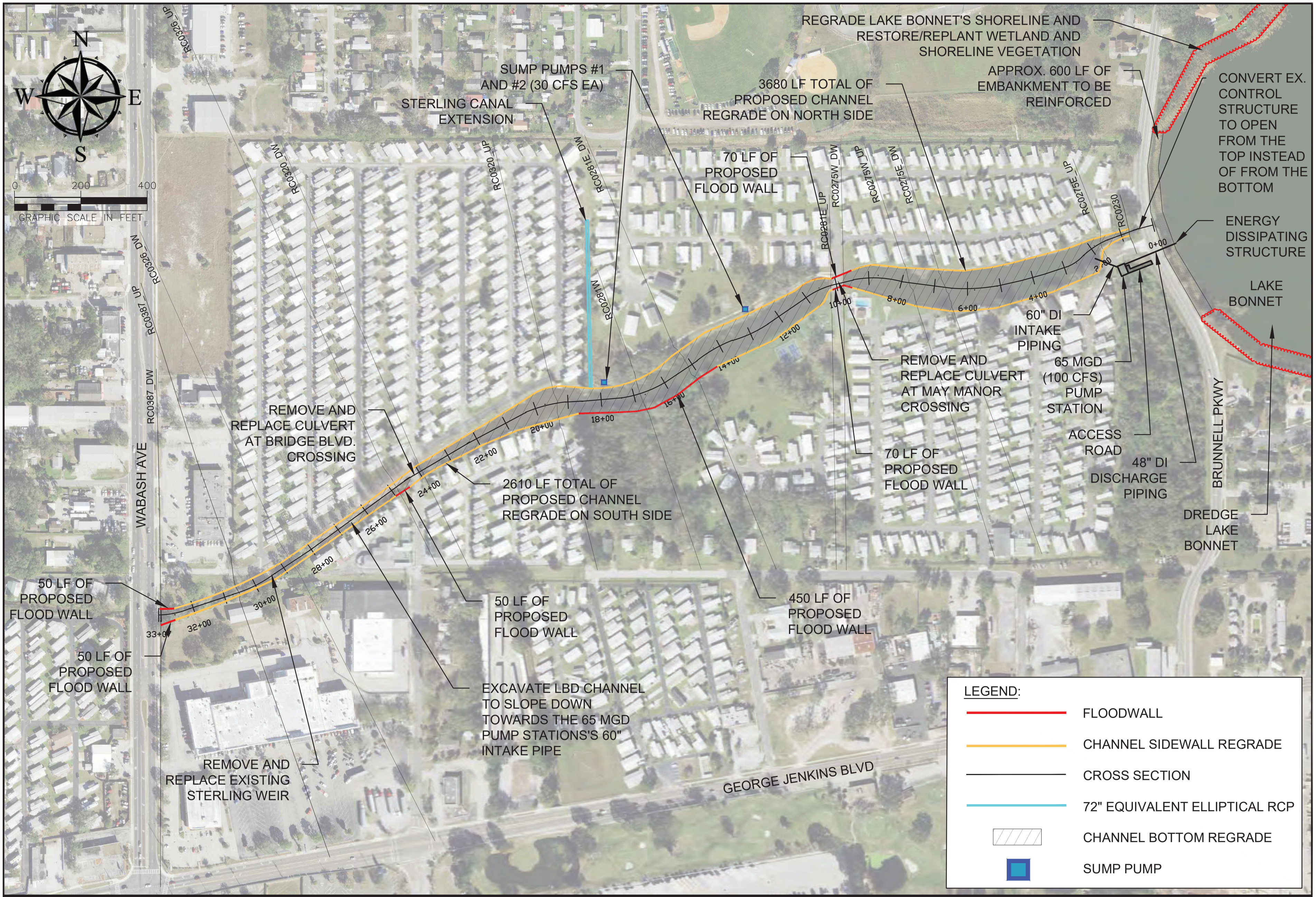
FIGURE 11



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 2 - CHANNEL IMPROVEMENT (FLOODWALLS)

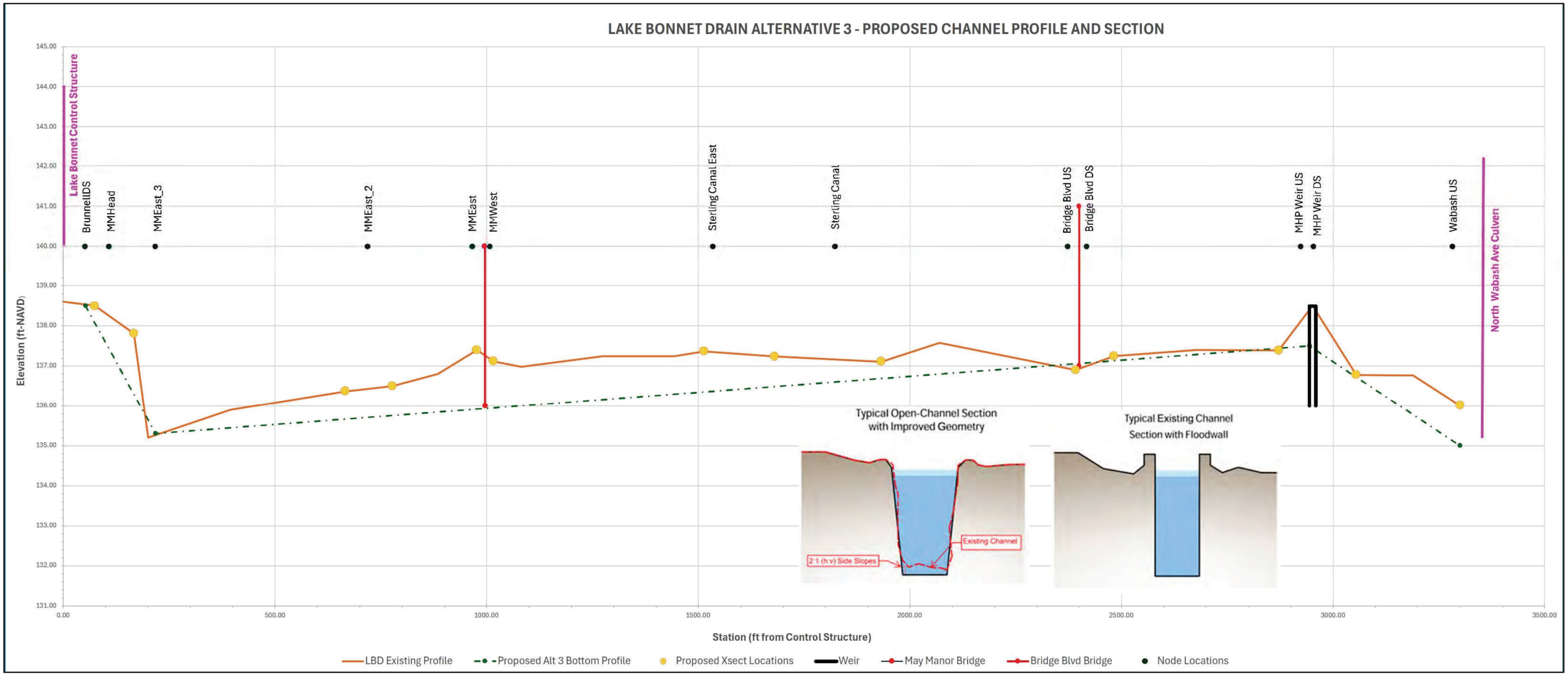
FIGURE 12



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 3 - BACKPUMPING TO LAKE BONNET

FIGURE
13



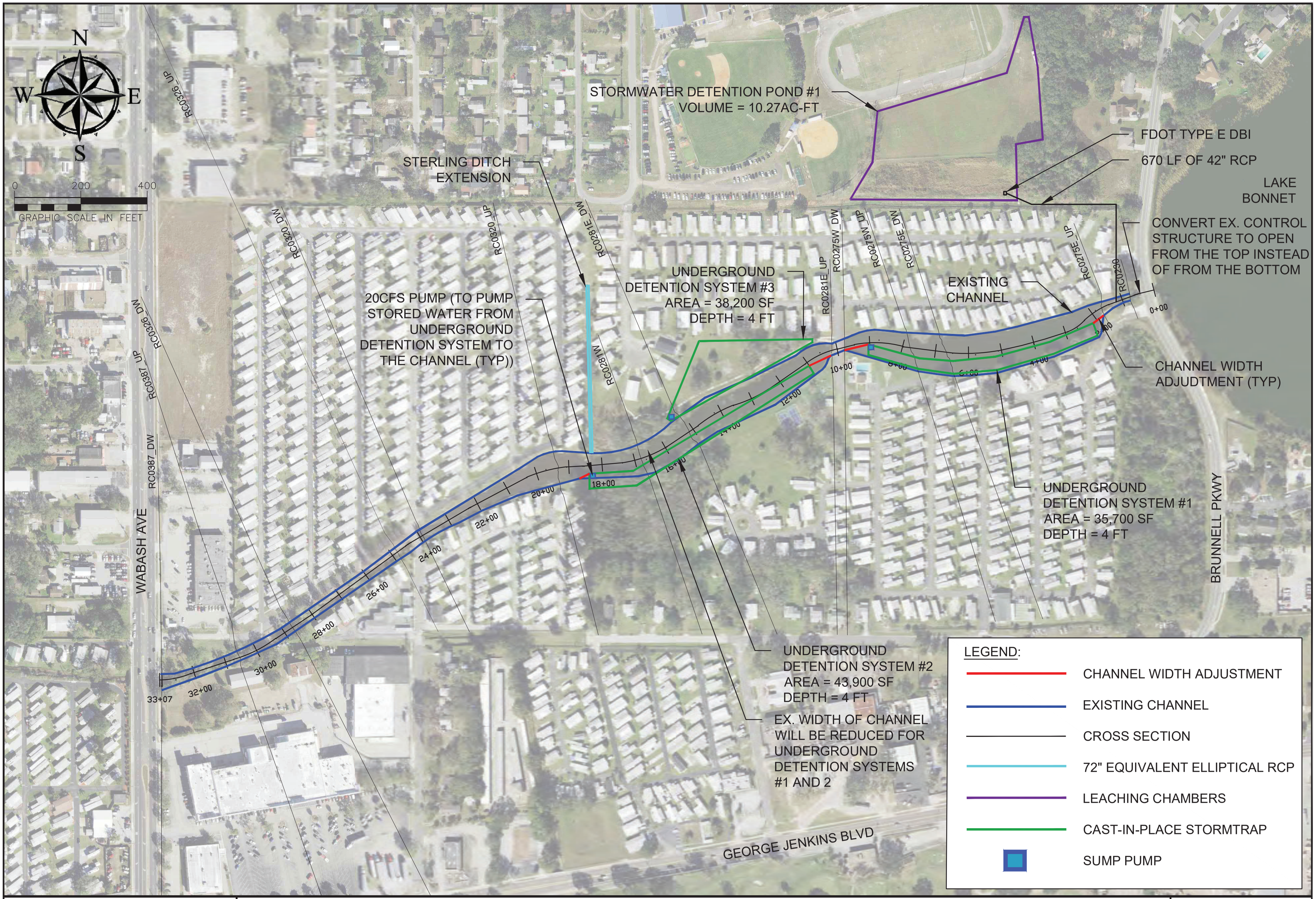
LAKE BONNET DRAIN ALTERNATIVE 3 - PROPOSED CHANNEL PROFILE AND SECTION

AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 3

PROPOSED CHANNEL PROFILE AND CROSS-SECTIONS

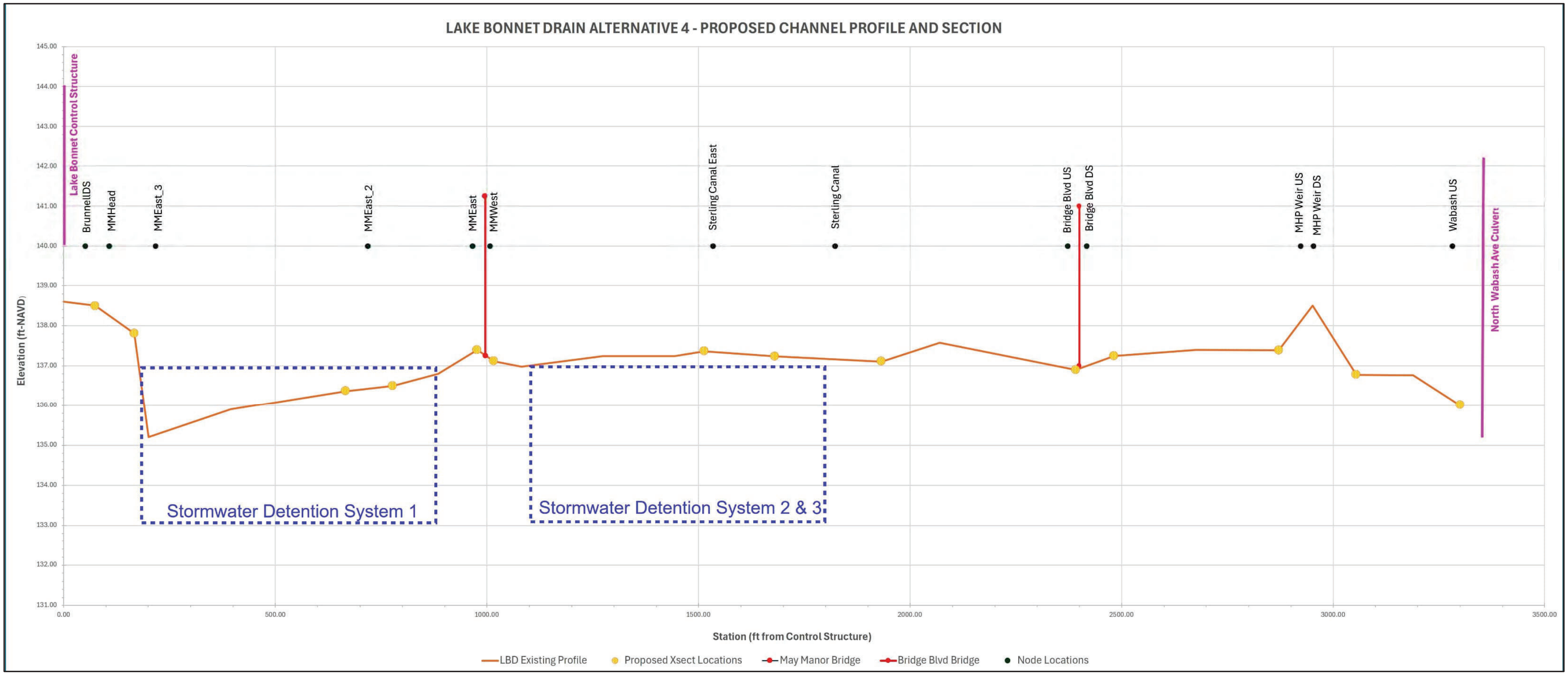
FIGURE 14



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 4 - DETENTION (POND / UNDERGROUND STORAGE)

FIGURE 15



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
ALTERNATIVE 4

PROPOSED CHANNEL PROFILE AND CROSS-SECTIONS

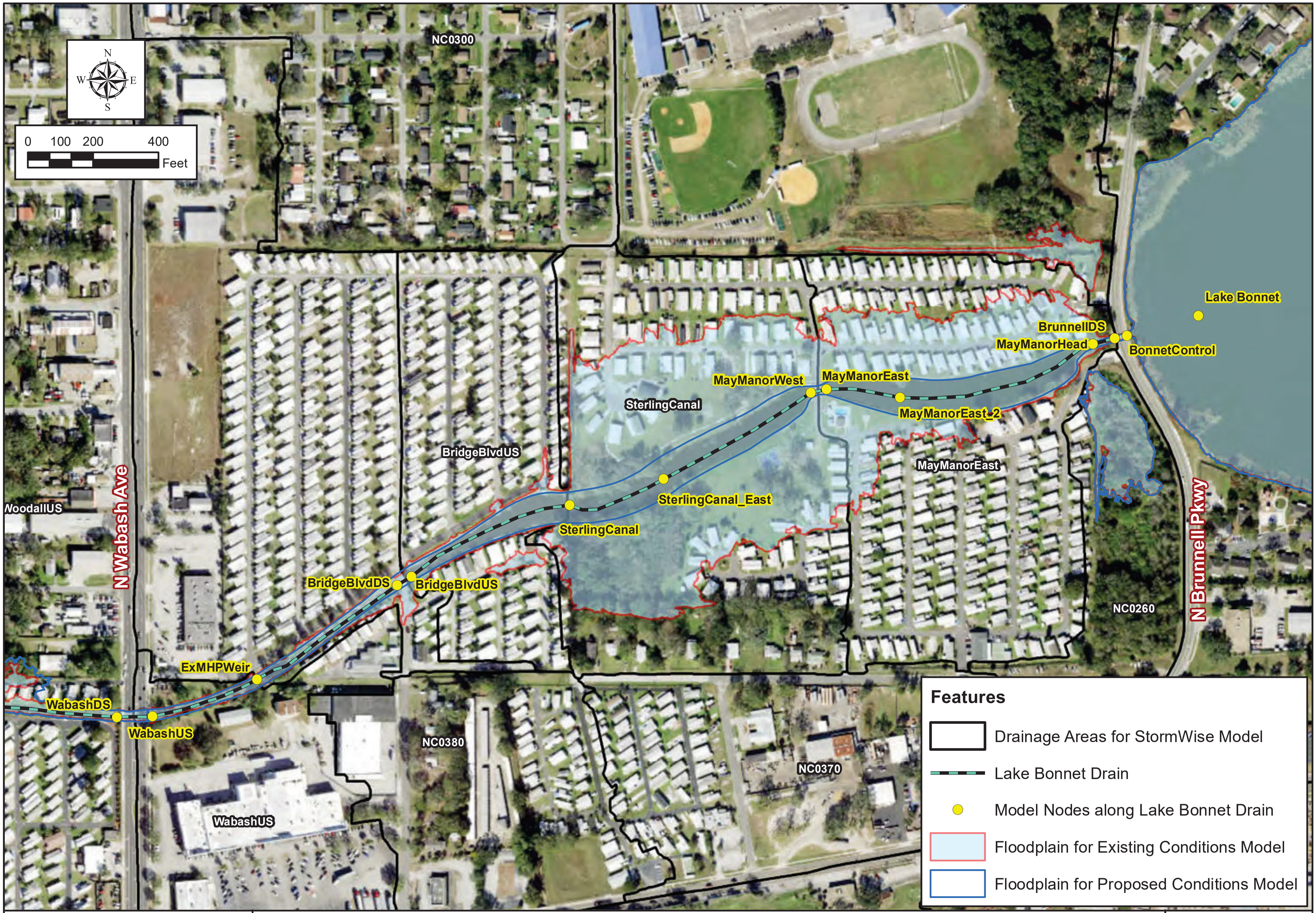
FIGURE 16

AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 1 - MEAN ANNUAL (2.33-YEAR) EVENT FLOODPLAIN MAP

FIGURE
17

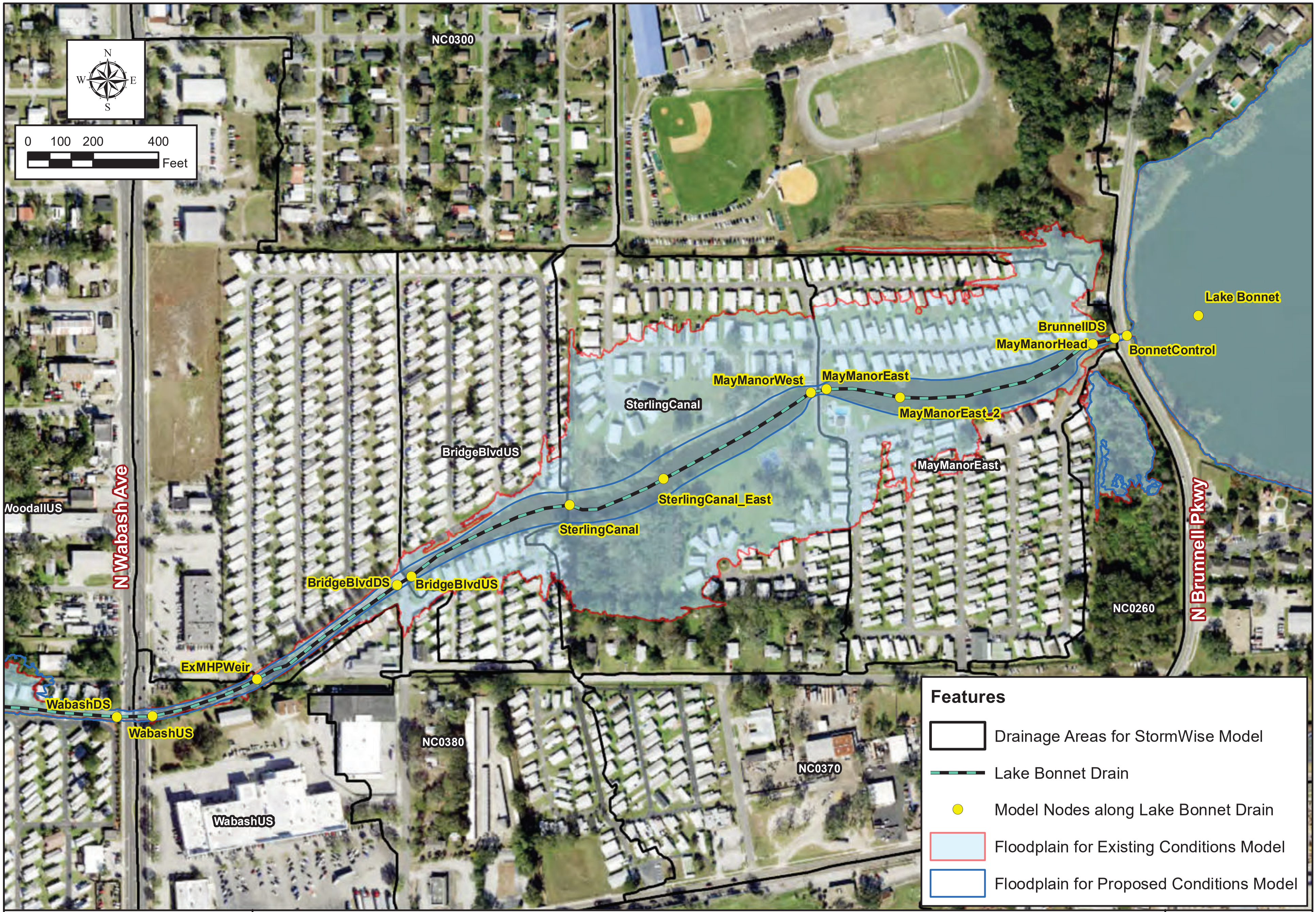


AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 1 - 10-YEAR EVENT FLOODPLAIN MAP

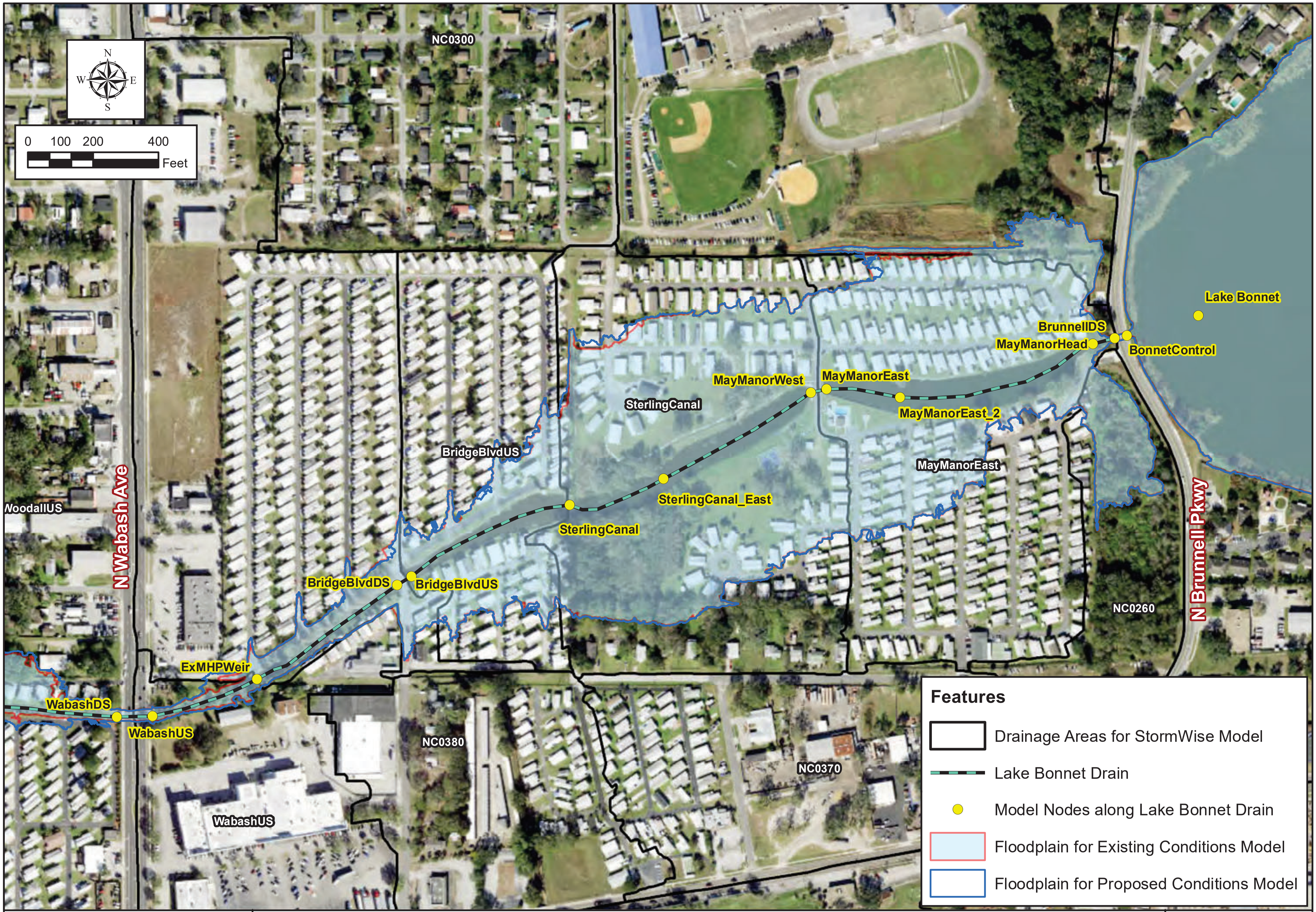
FIGURE
18



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 1 - 25-YEAR EVENT FLOODPLAIN MAP

FIGURE
19

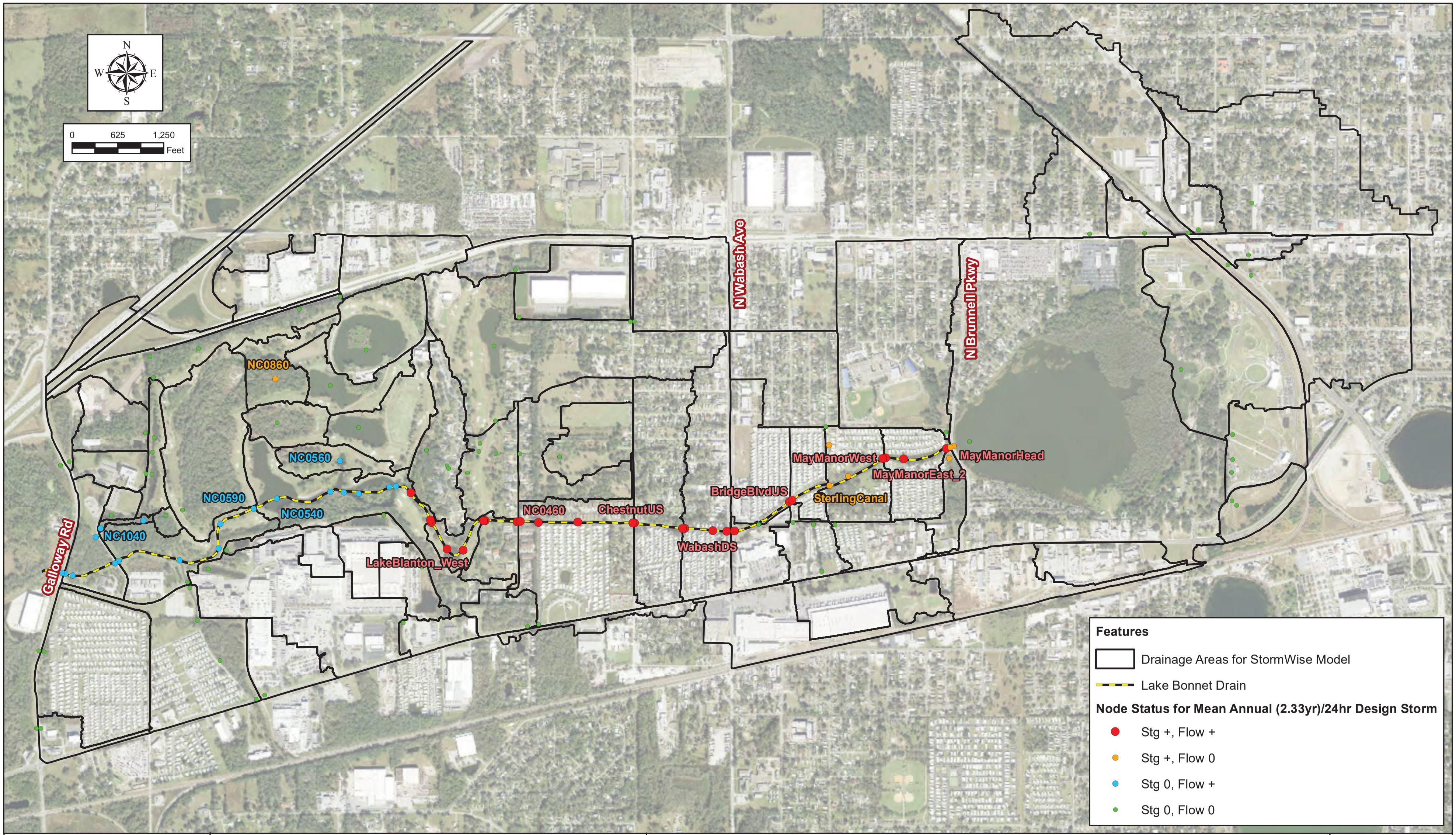


AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 1 - 100-YEAR EVENT FLOODPLAIN MAP

FIGURE
20

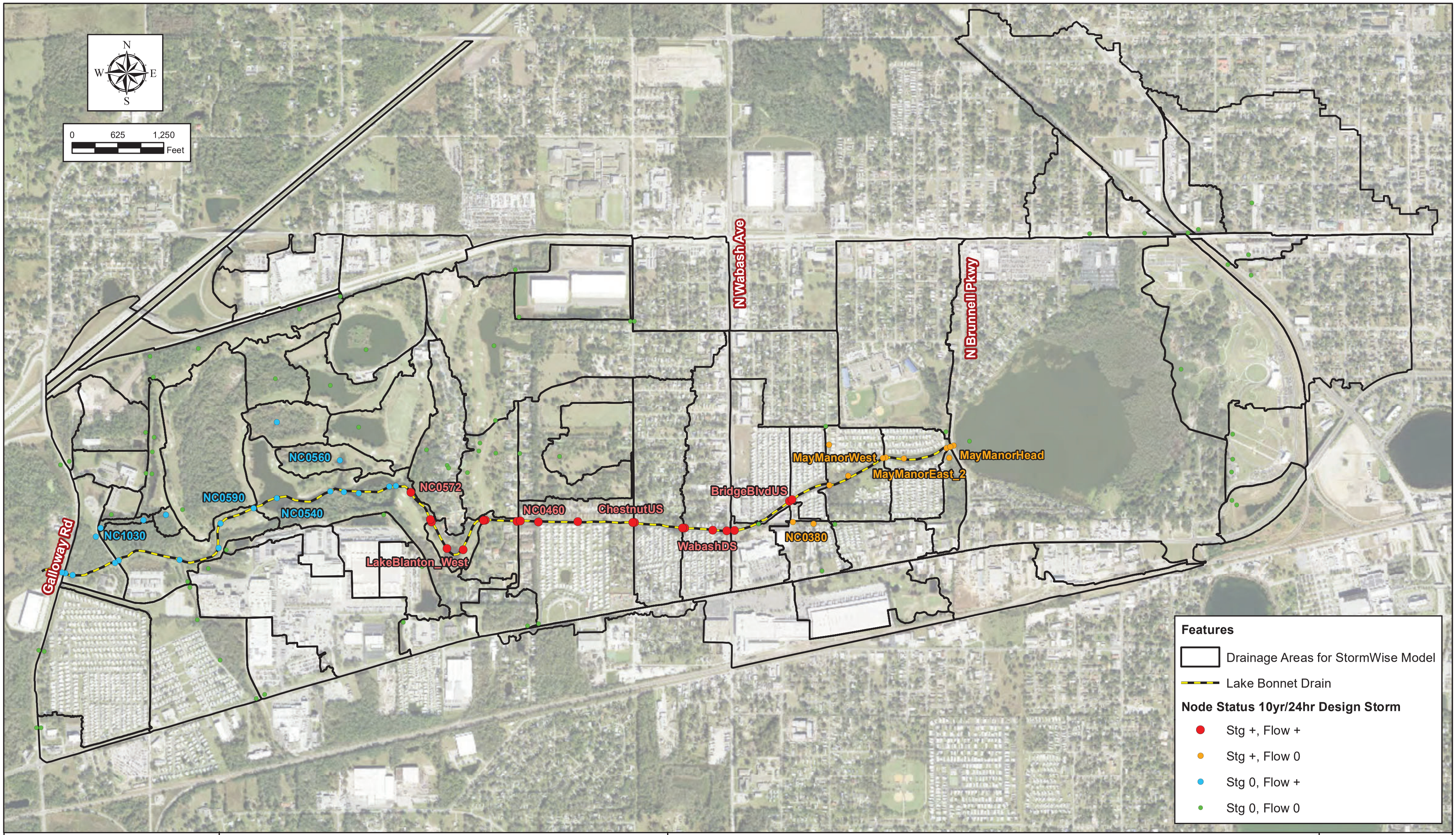


NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 1 - MEAN ANNUAL (2.33-YEAR) EVENT OFFSITE IMPACTS MAP

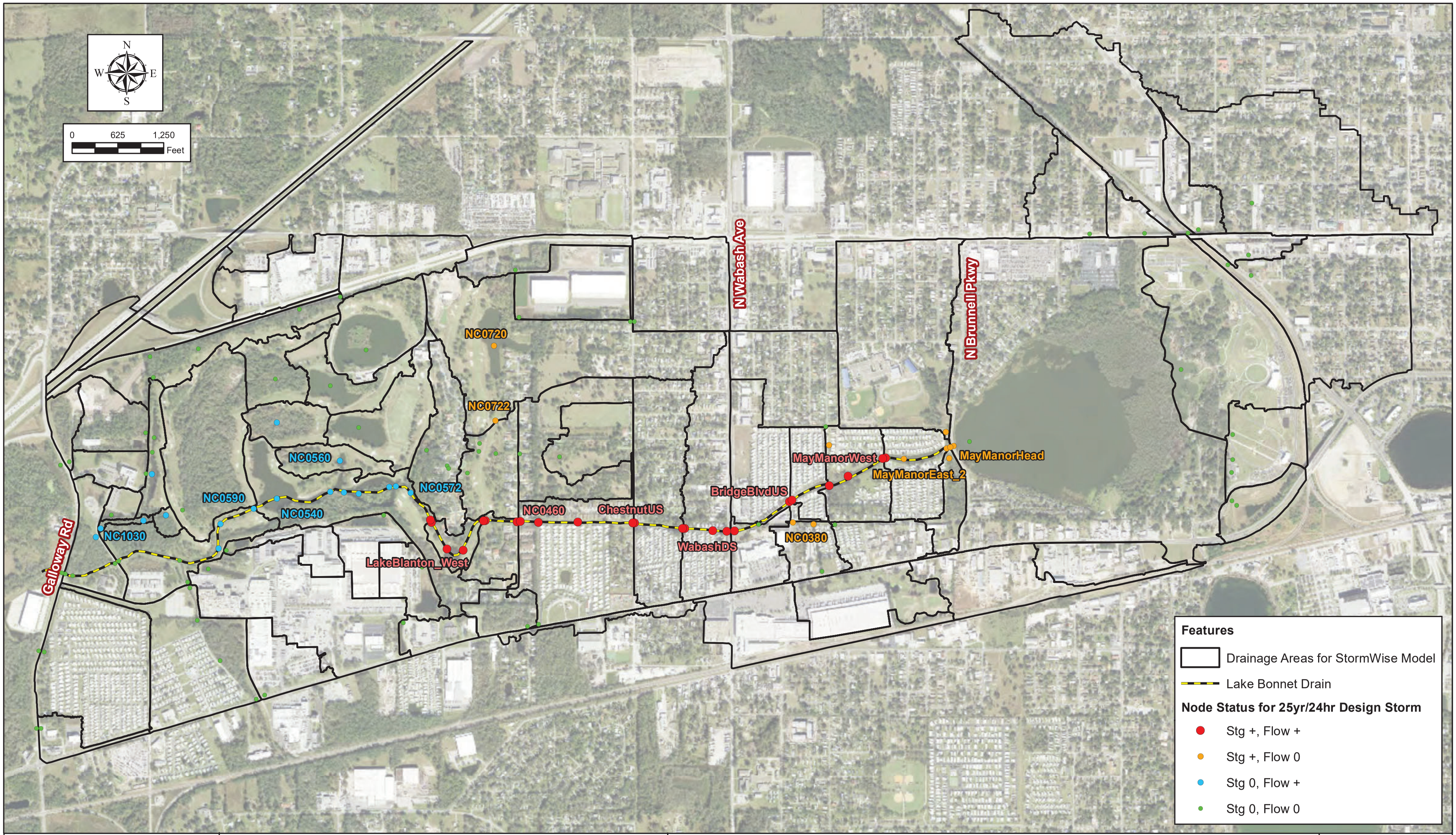
FIGURE
21



NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 1 - 10-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
22



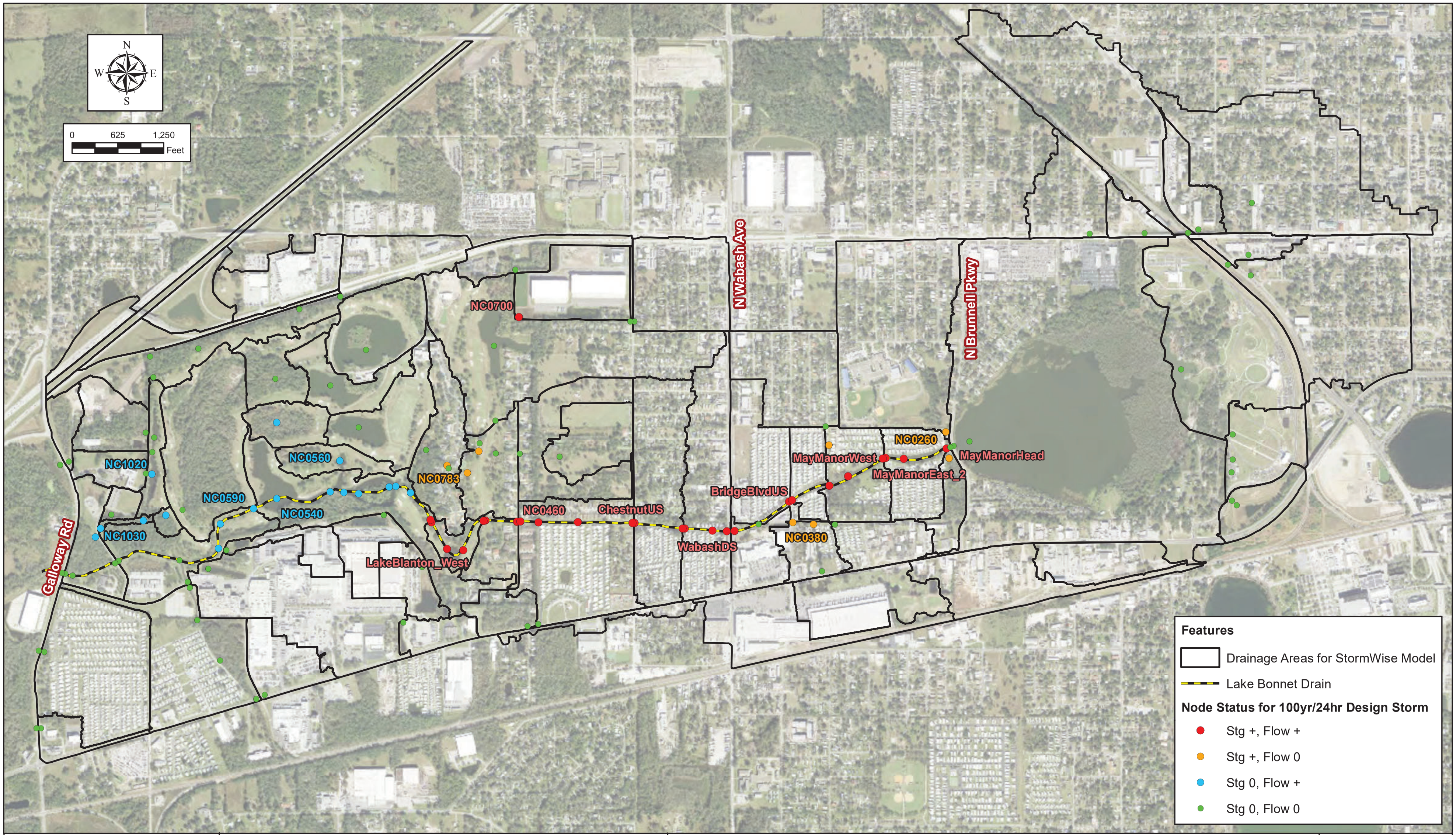
AECOM

NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 1 - 25-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
23



AECOM

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LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 1 - 100-YEAR EVENT OFFSITE IMPACTS MAP

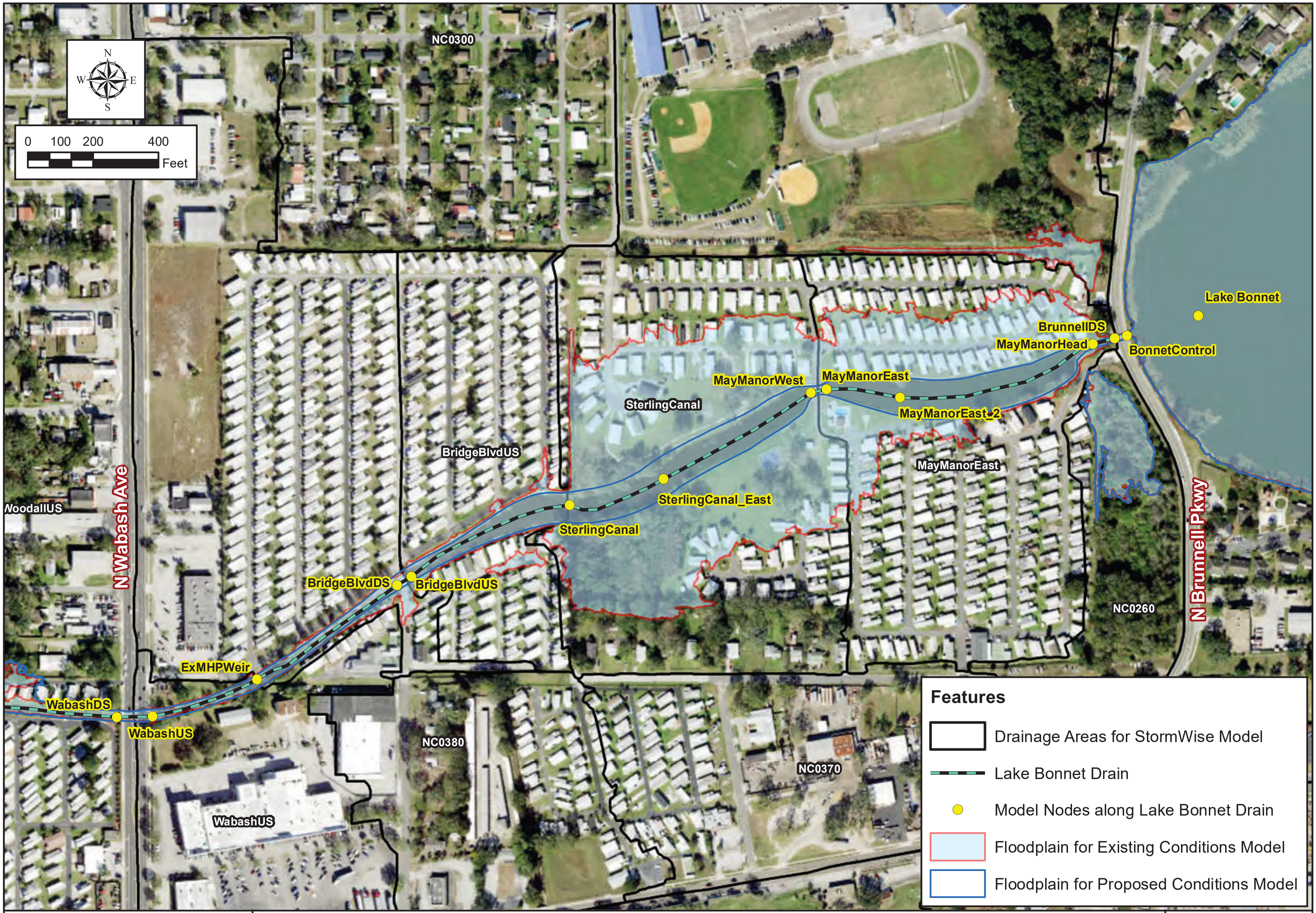
FIGURE
24

AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 2 - MEAN ANNUAL (2.33-YEAR) EVENT FLOODPLAIN MAP

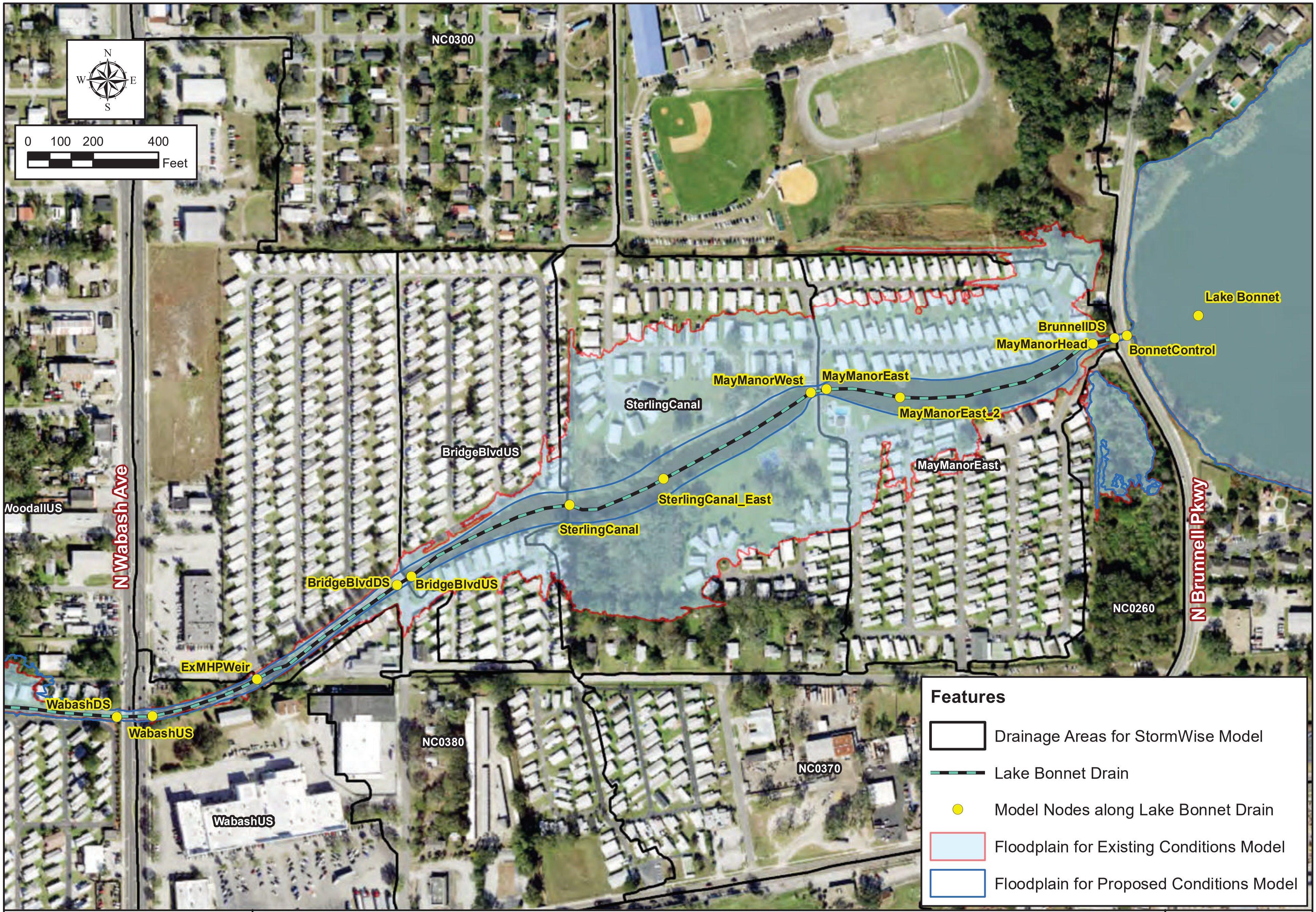
FIGURE
25



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - 10-YEAR EVENT FLOODPLAIN MAP

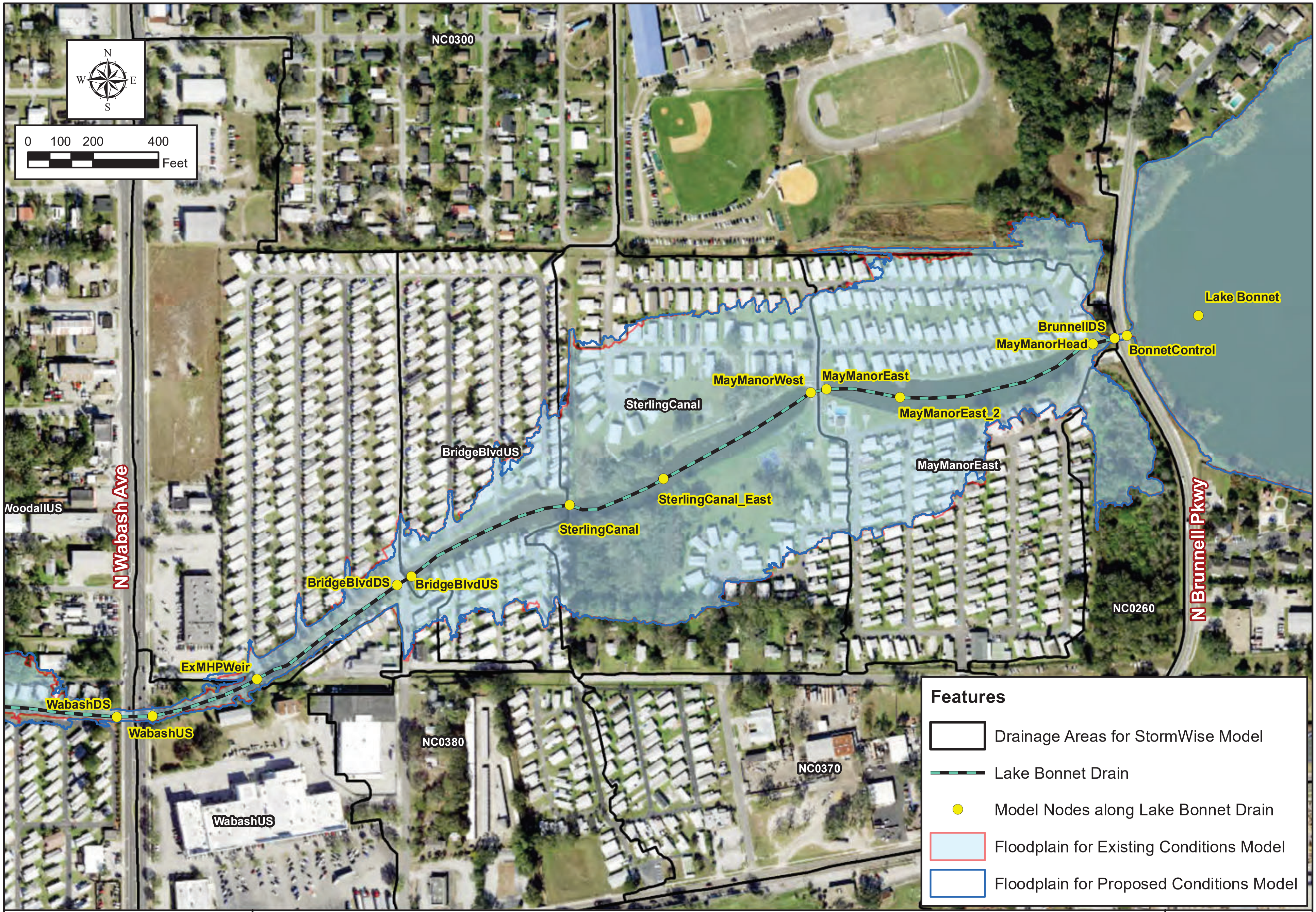
FIGURE
26



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - 25-YEAR EVENT FLOODPLAIN MAP

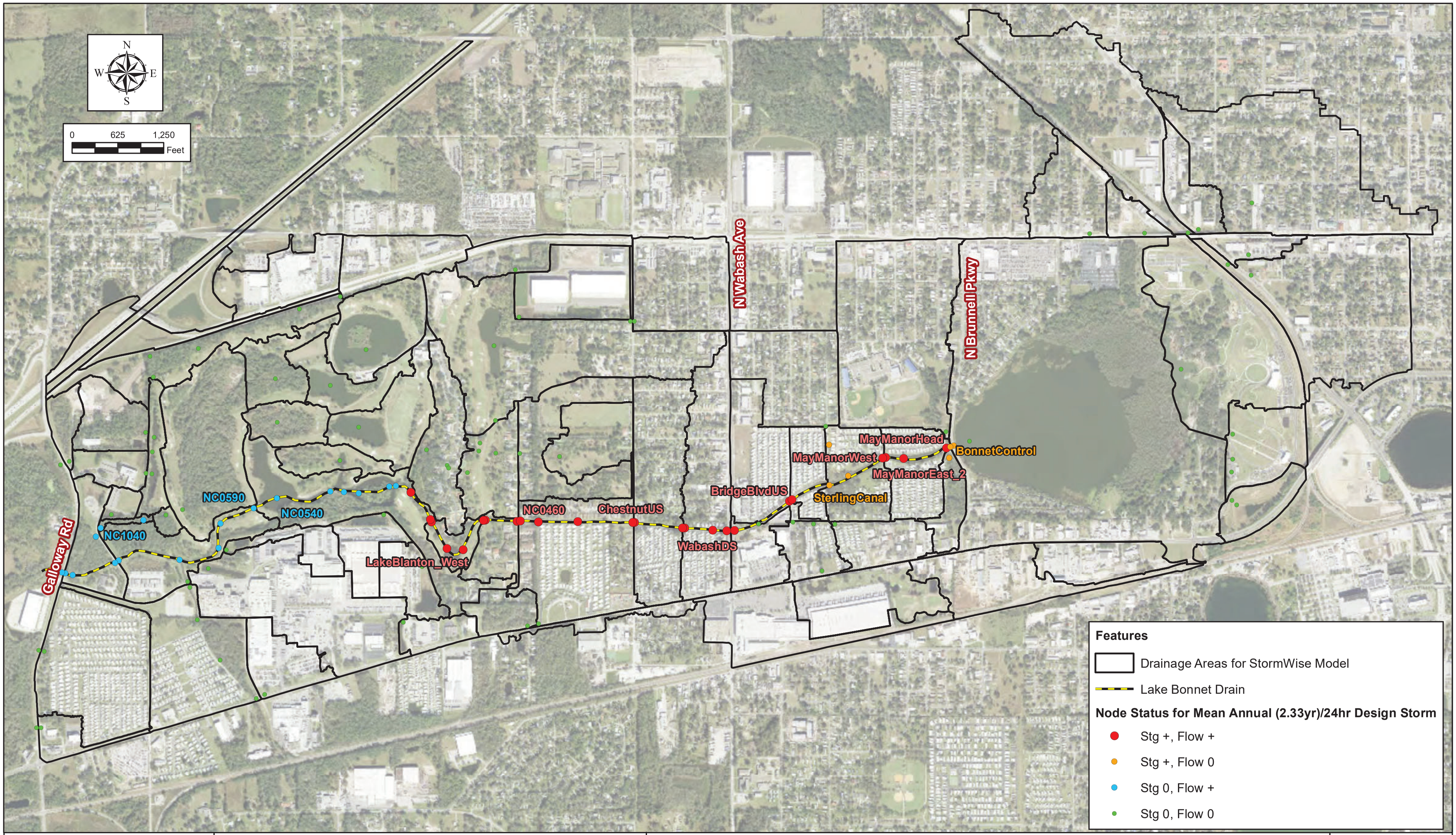
FIGURE
27



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - 100-YEAR EVENT FLOODPLAIN MAP

FIGURE
28

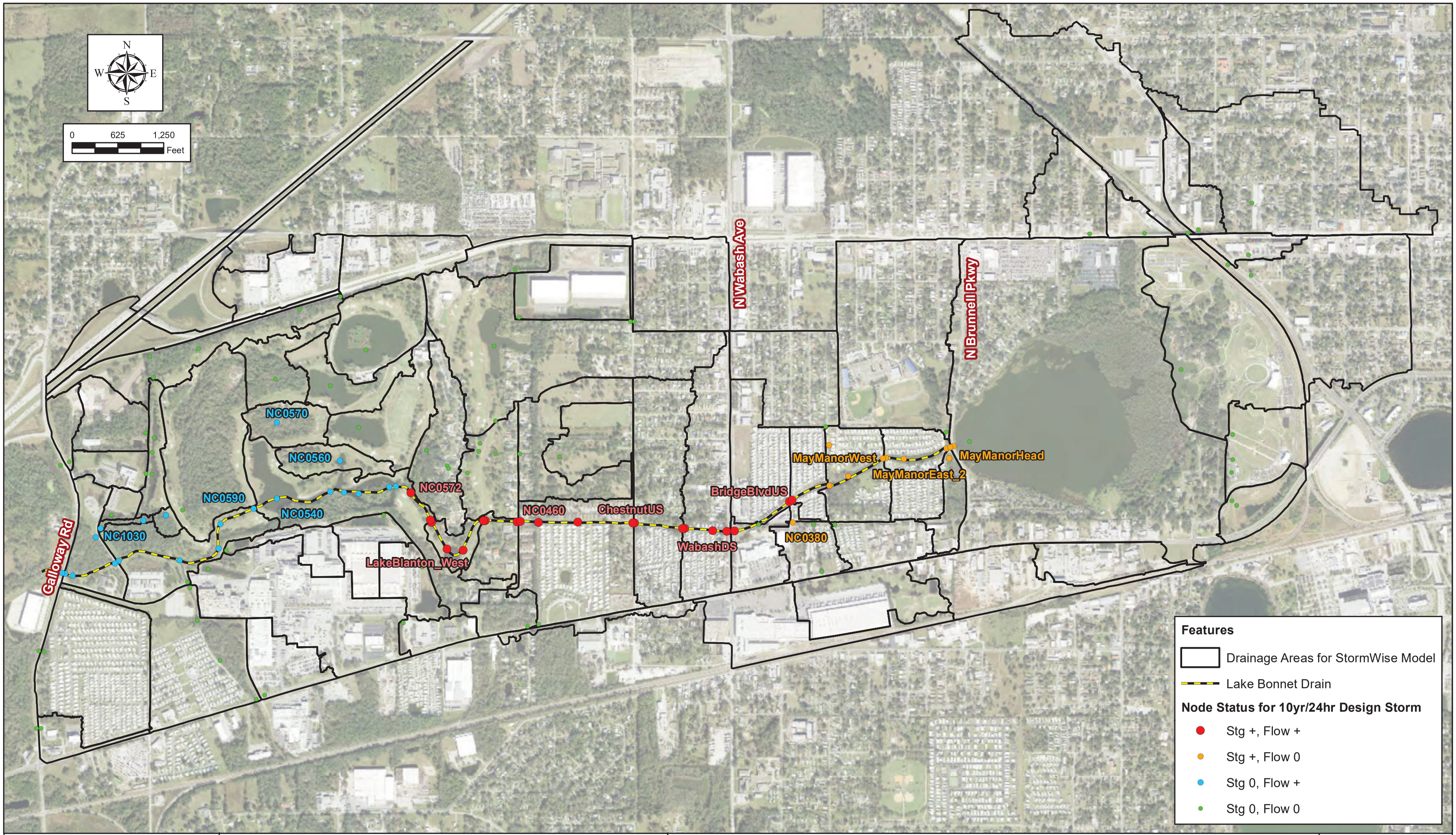


AECOM

NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - MEAN ANNUAL (2.33-YEAR) EVENT OFFSITE IMPACTS MAP

FIGURE
29



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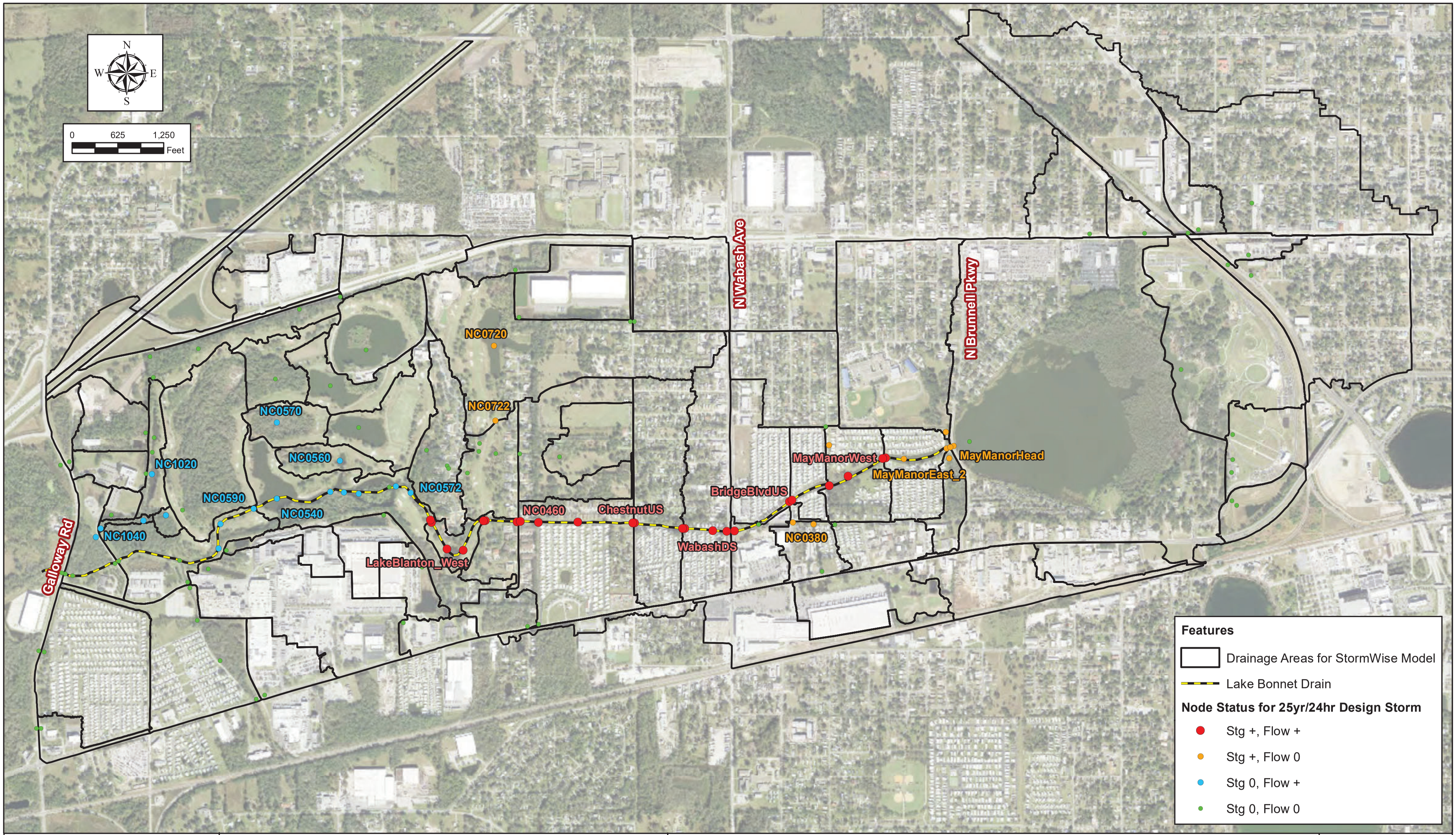
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 2 - 10-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
30



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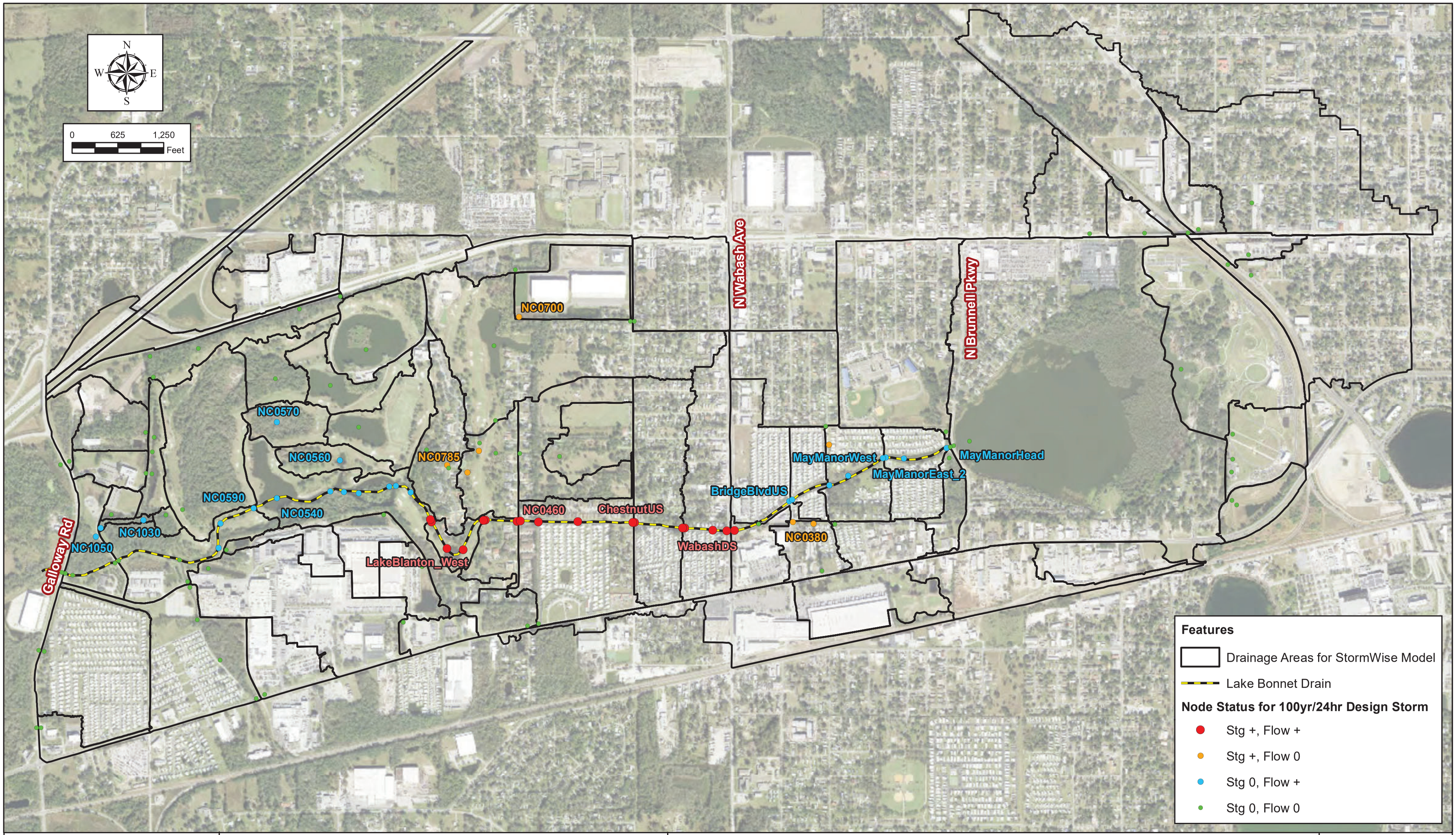
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - 25-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
31



AECOM

NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 2 - 100-YEAR EVENT OFFSITE IMPACTS MAP

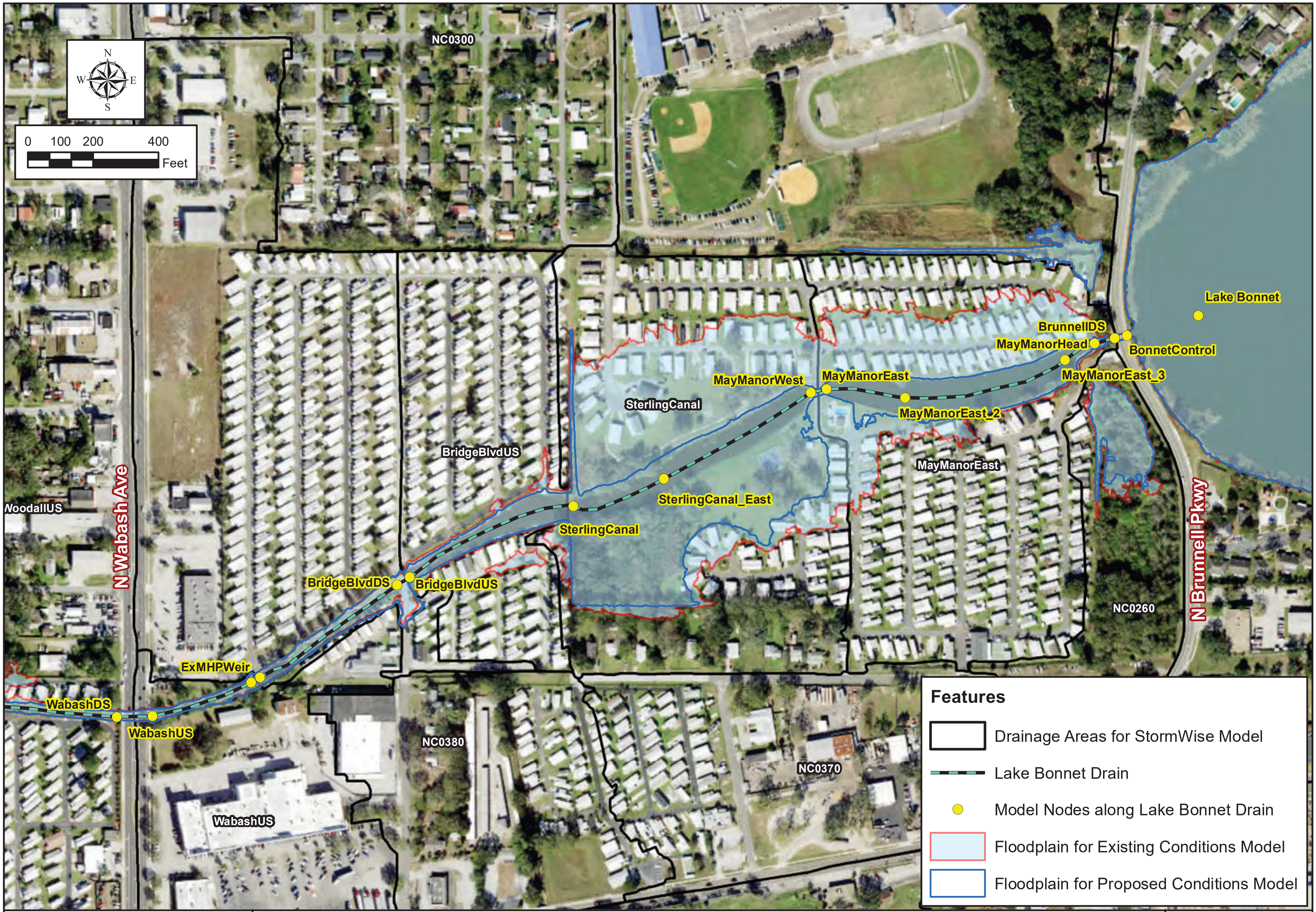
FIGURE
32

AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

MEAN ANNUAL (2.33-YEAR) / 24-HOUR FLOOD MAP FOR PROPOSED ALTERNATIVE 3

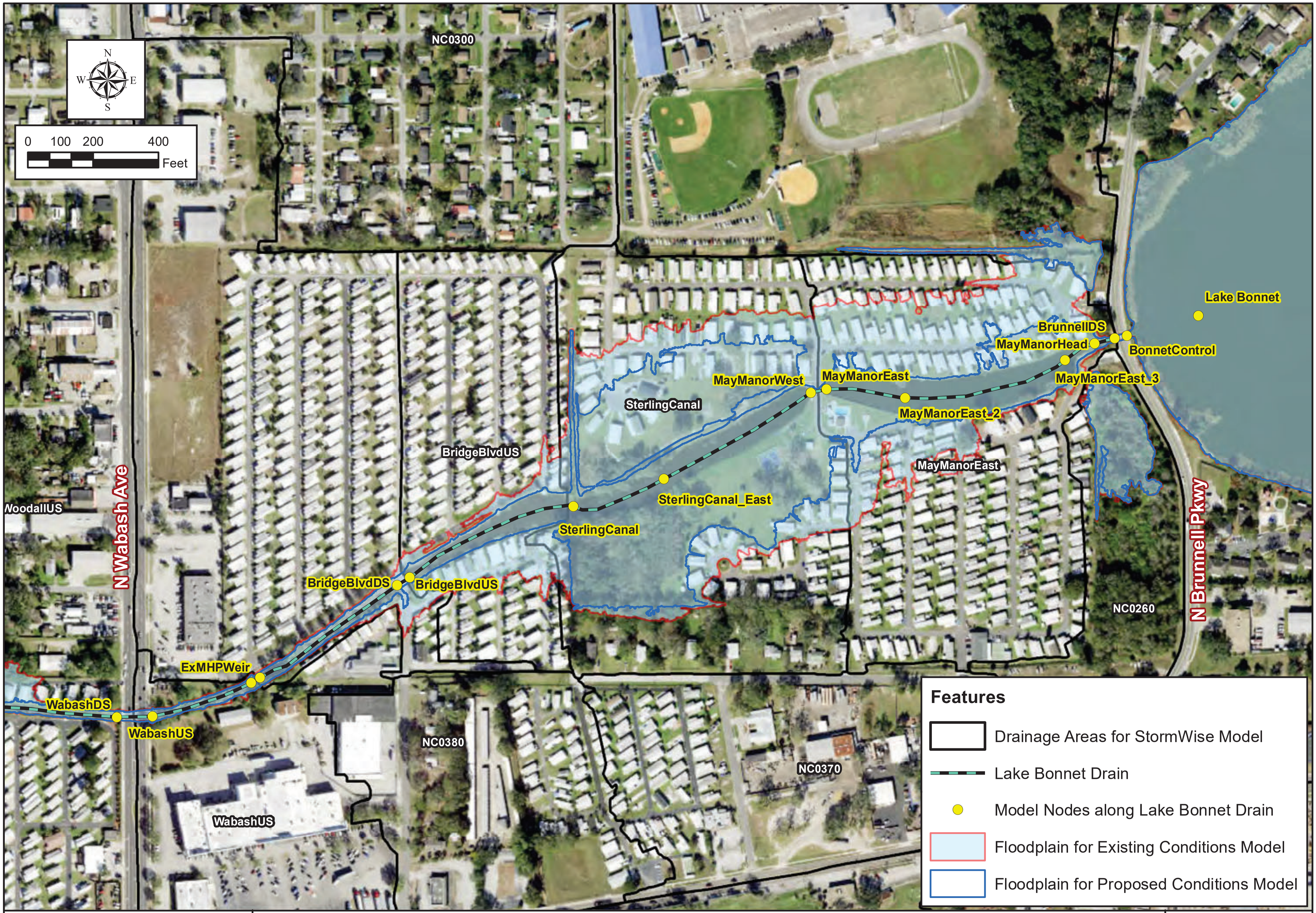
FIGURE
33



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
10-YEAR / 24-HOUR FLOOD MAP FOR PROPOSED ALTERNATIVE 3

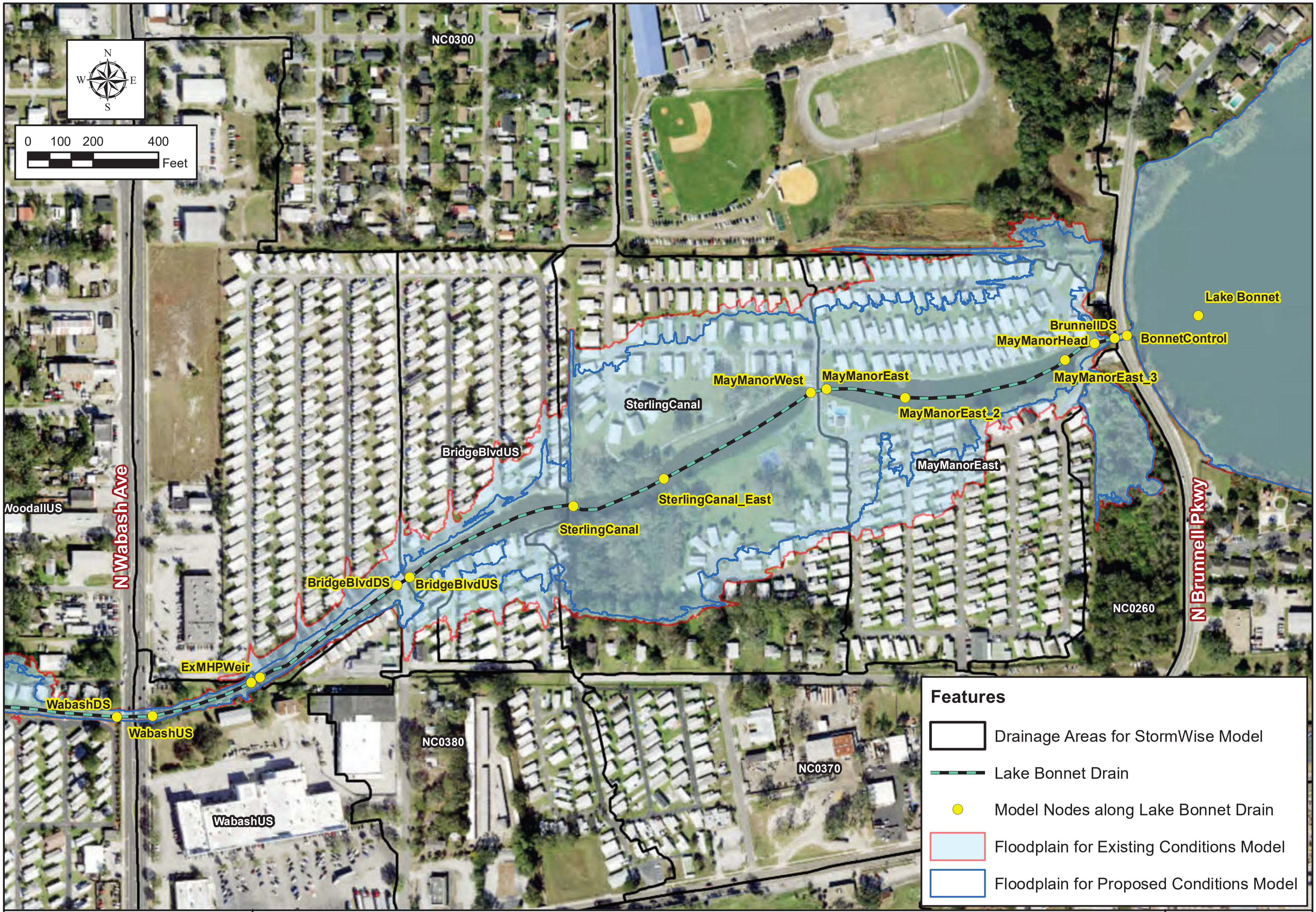
FIGURE
34



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - 25-YEAR EVENT FLOODPLAIN MAP

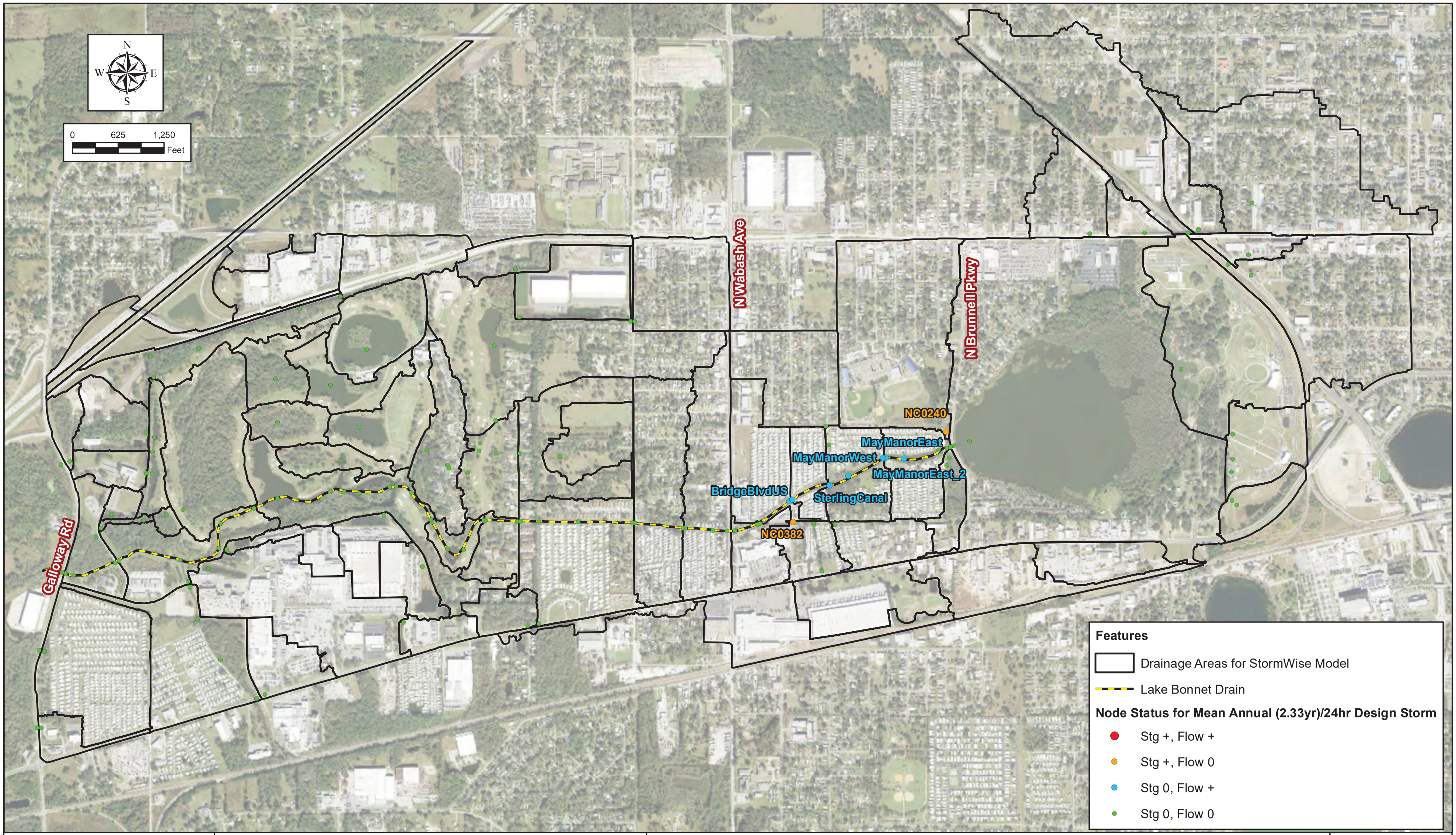
FIGURE
35



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - 100-YEAR EVENT FLOODPLAIN MAP

FIGURE
36



AECOM

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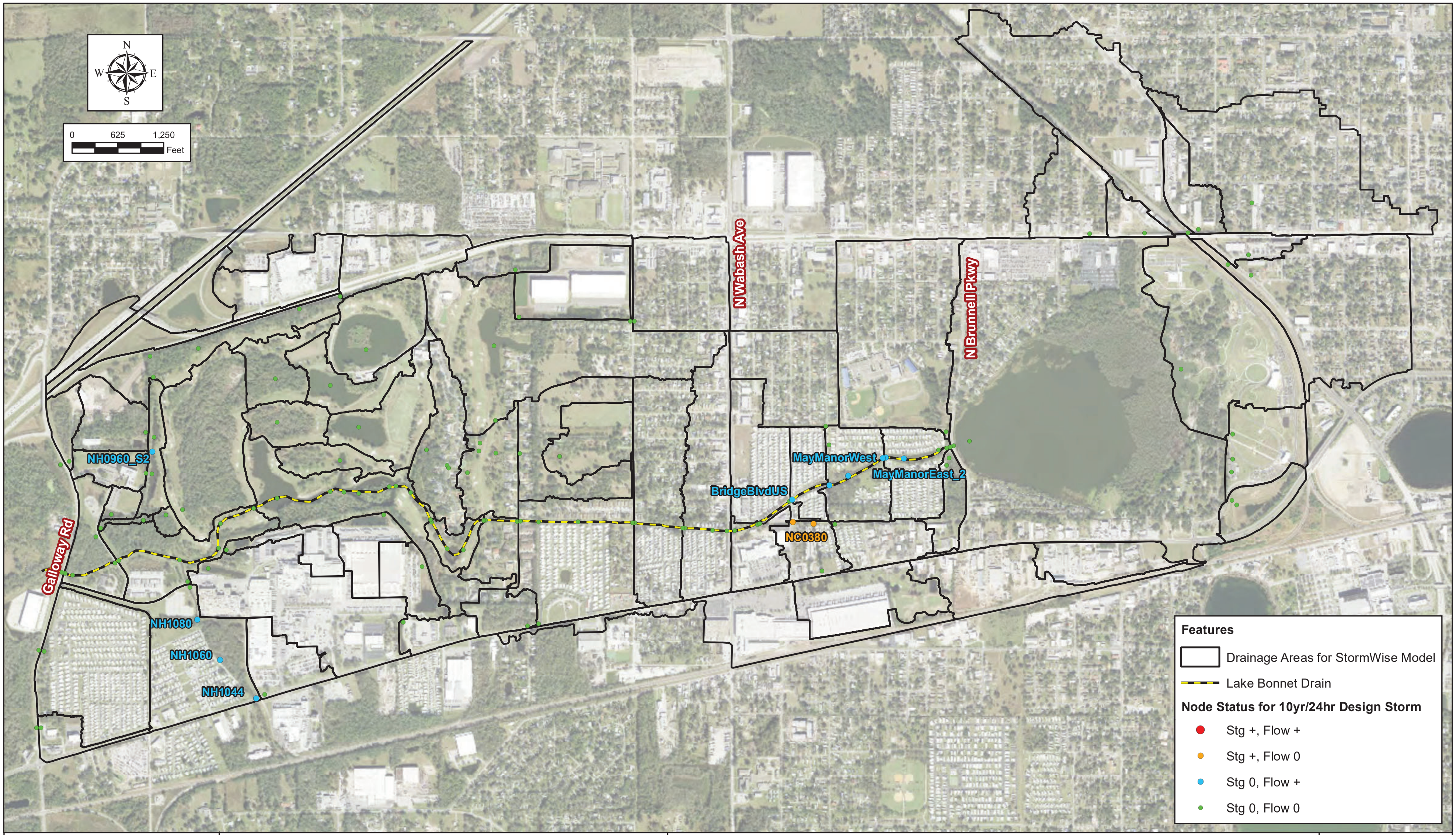
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - MEAN ANNUAL (2.33-YEAR) EVENT OFFSITE IMPACTS MAP

FIGURE 37



AECOM

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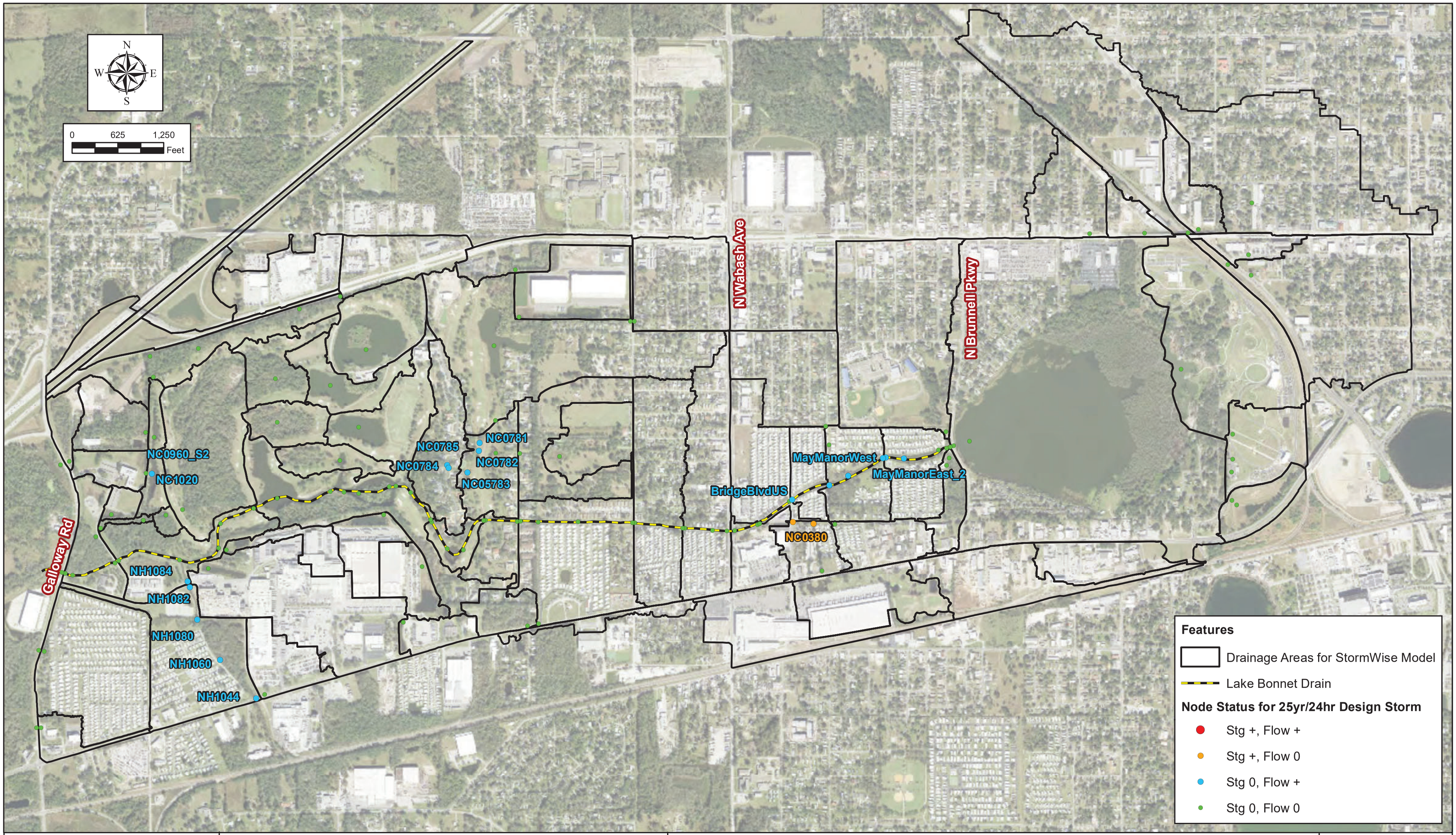
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - 10-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
38



AECOM

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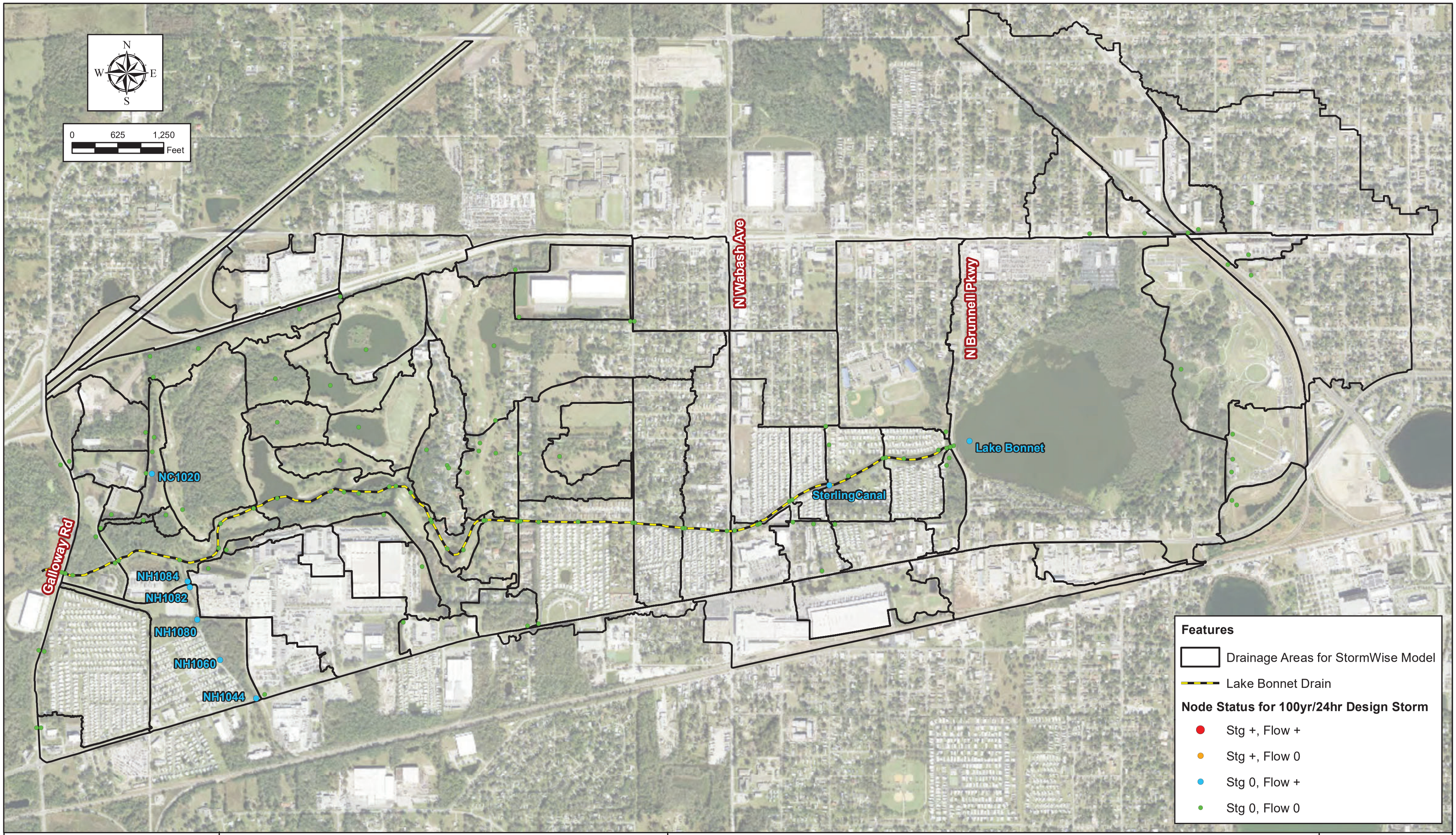
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - 25-YEAR EVENT OFFSITE IMPACTS MAP

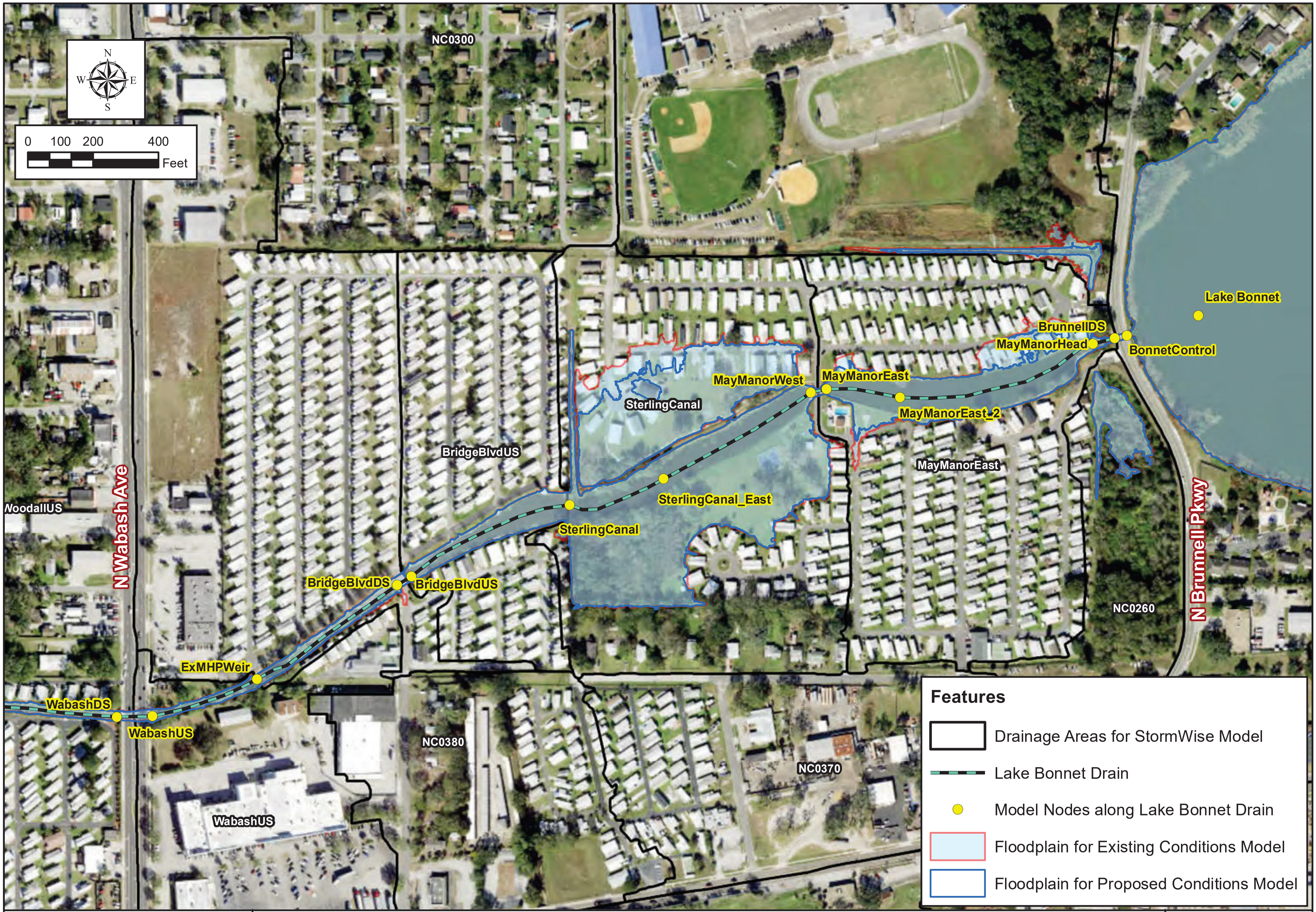
FIGURE
39



NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 3 - 100-YEAR EVENT OFFSITE IMPACTS MAP

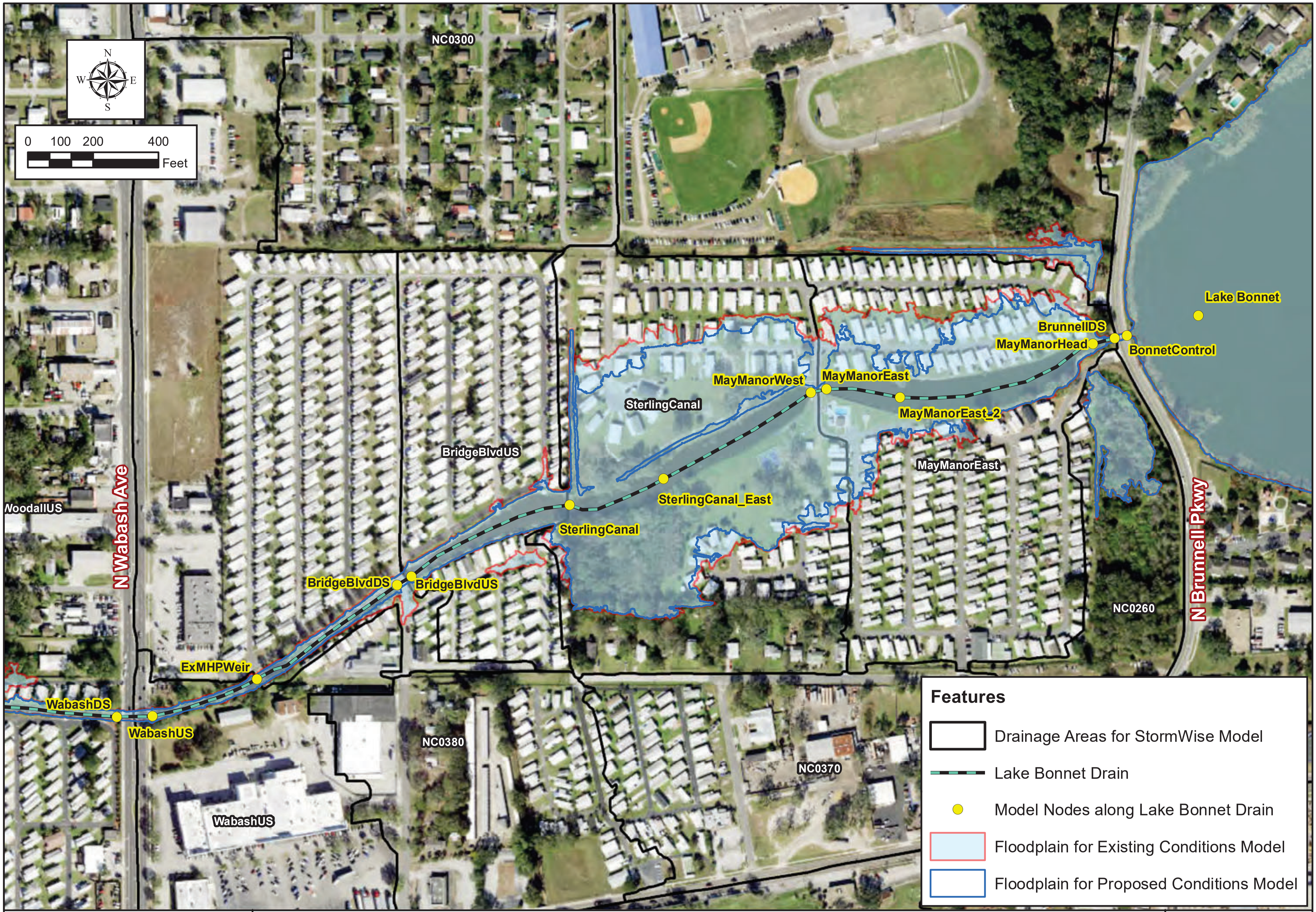
FIGURE
40



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - MEAN ANNUAL (2.33-YEAR) EVENT FLOODPLAIN MAP

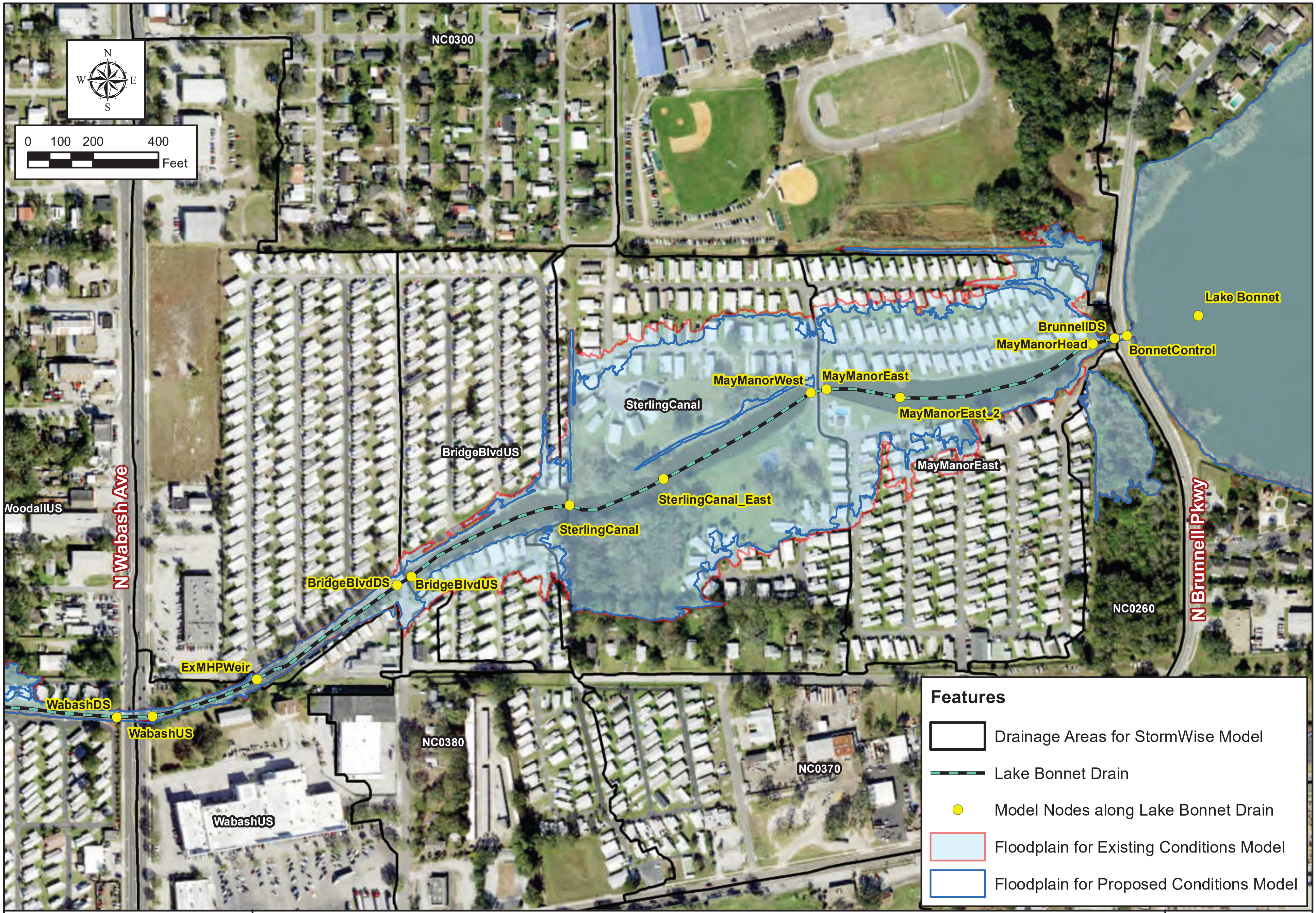
FIGURE
41



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - 10-YEAR EVENT FLOODPLAIN MAP

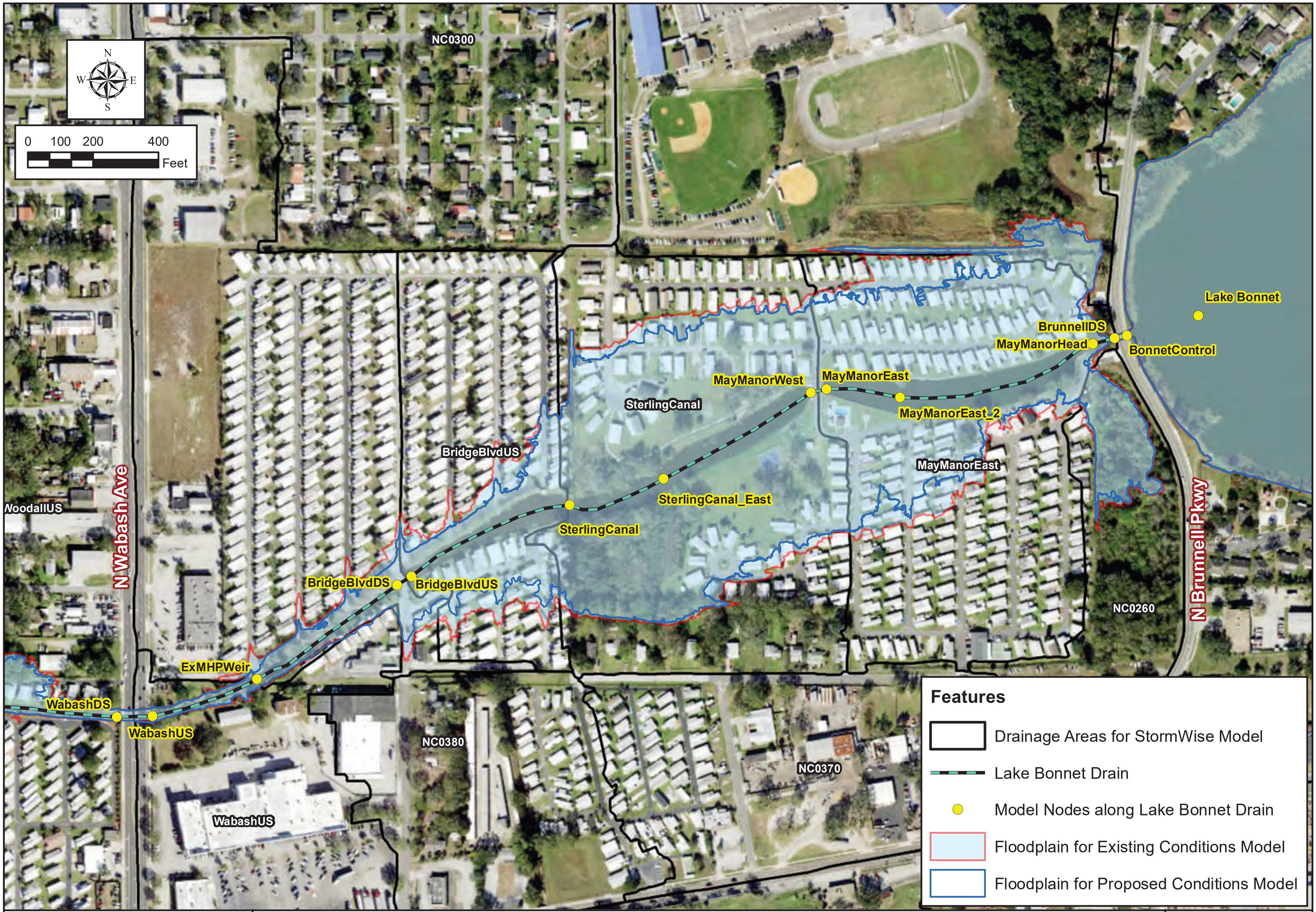
FIGURE
42



AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - 25-YEAR EVENT FLOODPLAIN MAP

FIGURE
43

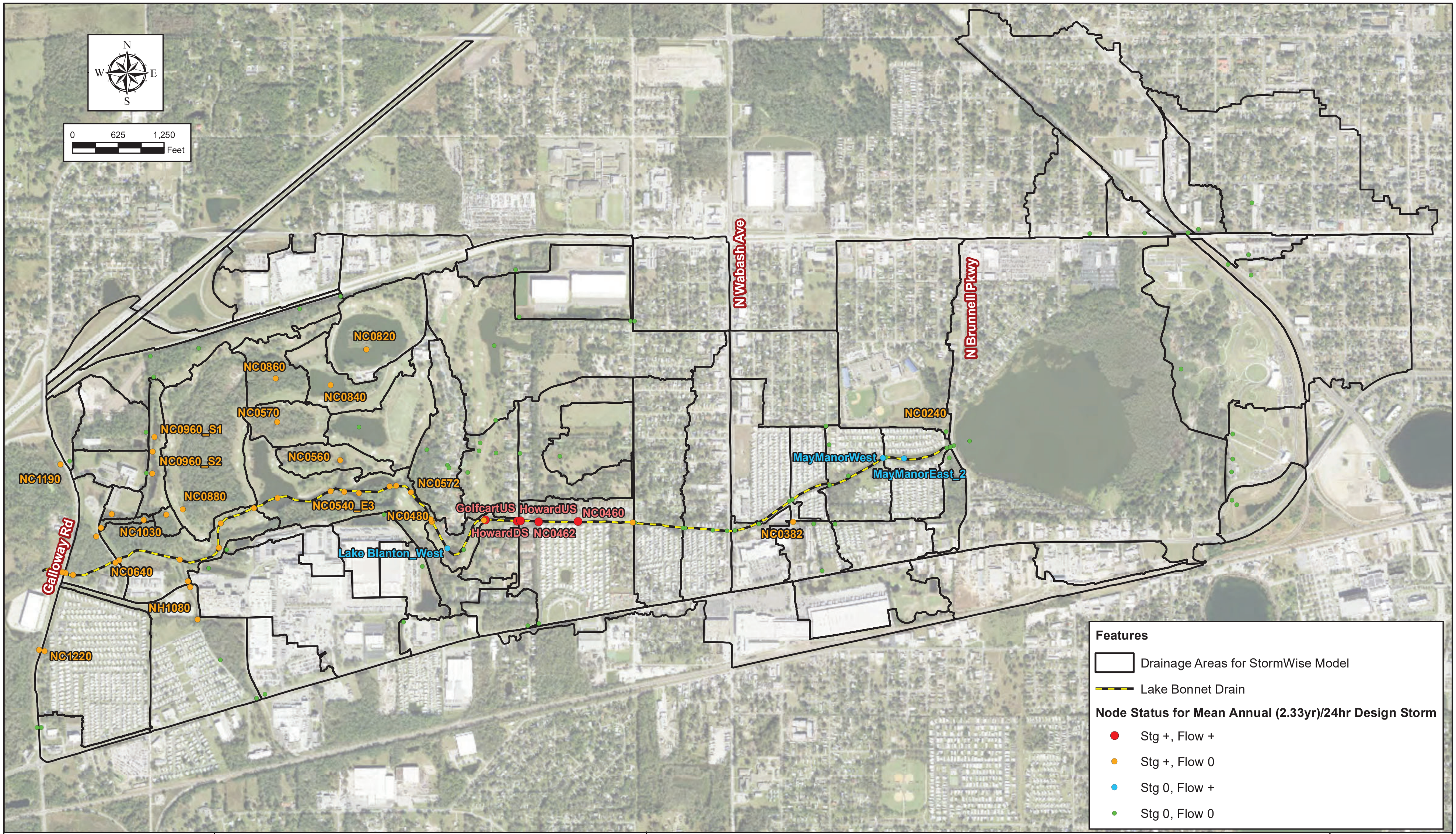


AECOM

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND

ALTERNATIVE 4 - 100-YEAR EVENT FLOODPLAIN MAP

FIGURE
44

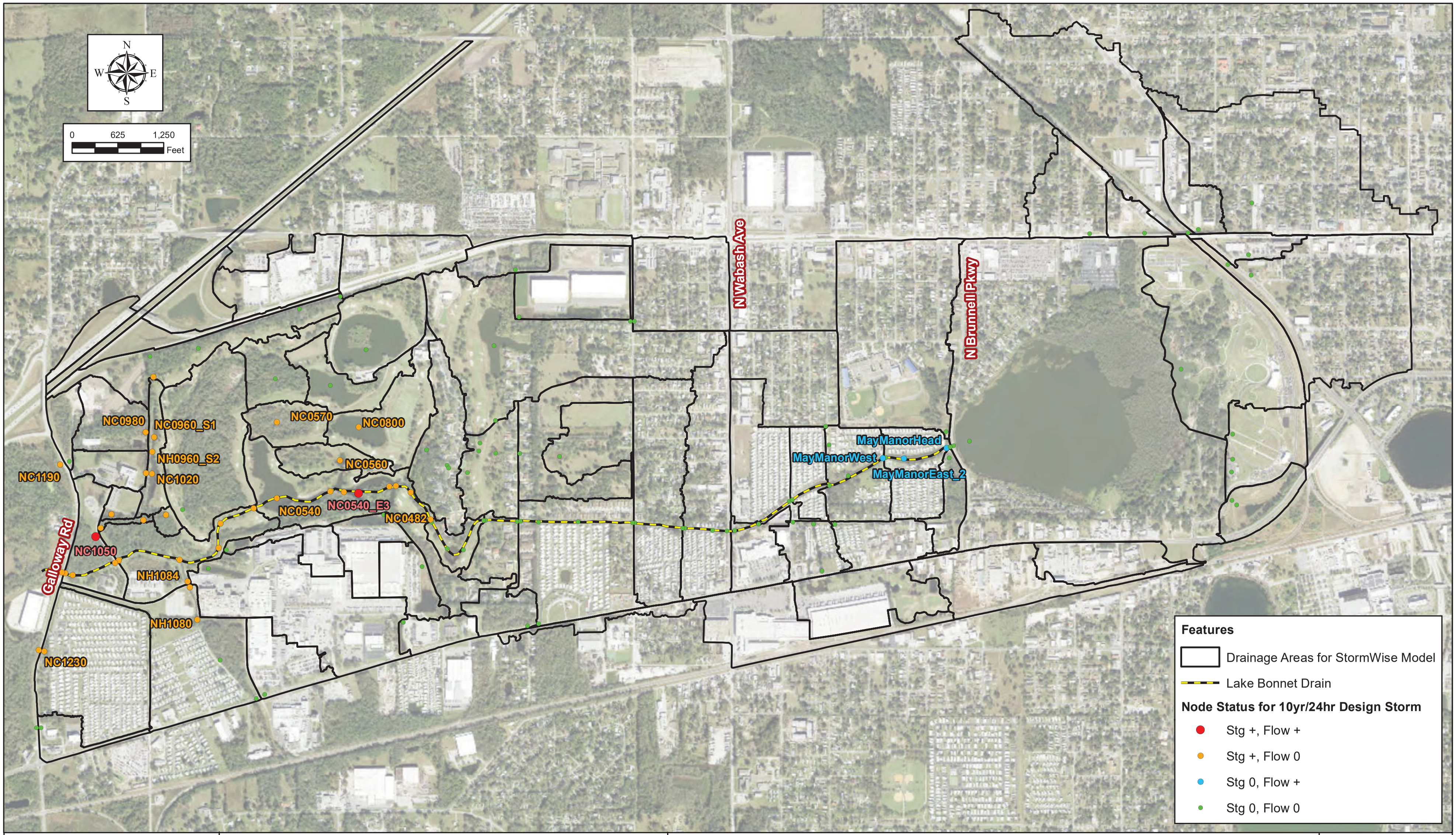


AECOM

NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - MEAN ANNUAL (2.33-YEAR) EVENT OFFSITE IMPACTS MAP

FIGURE
45



AECOM

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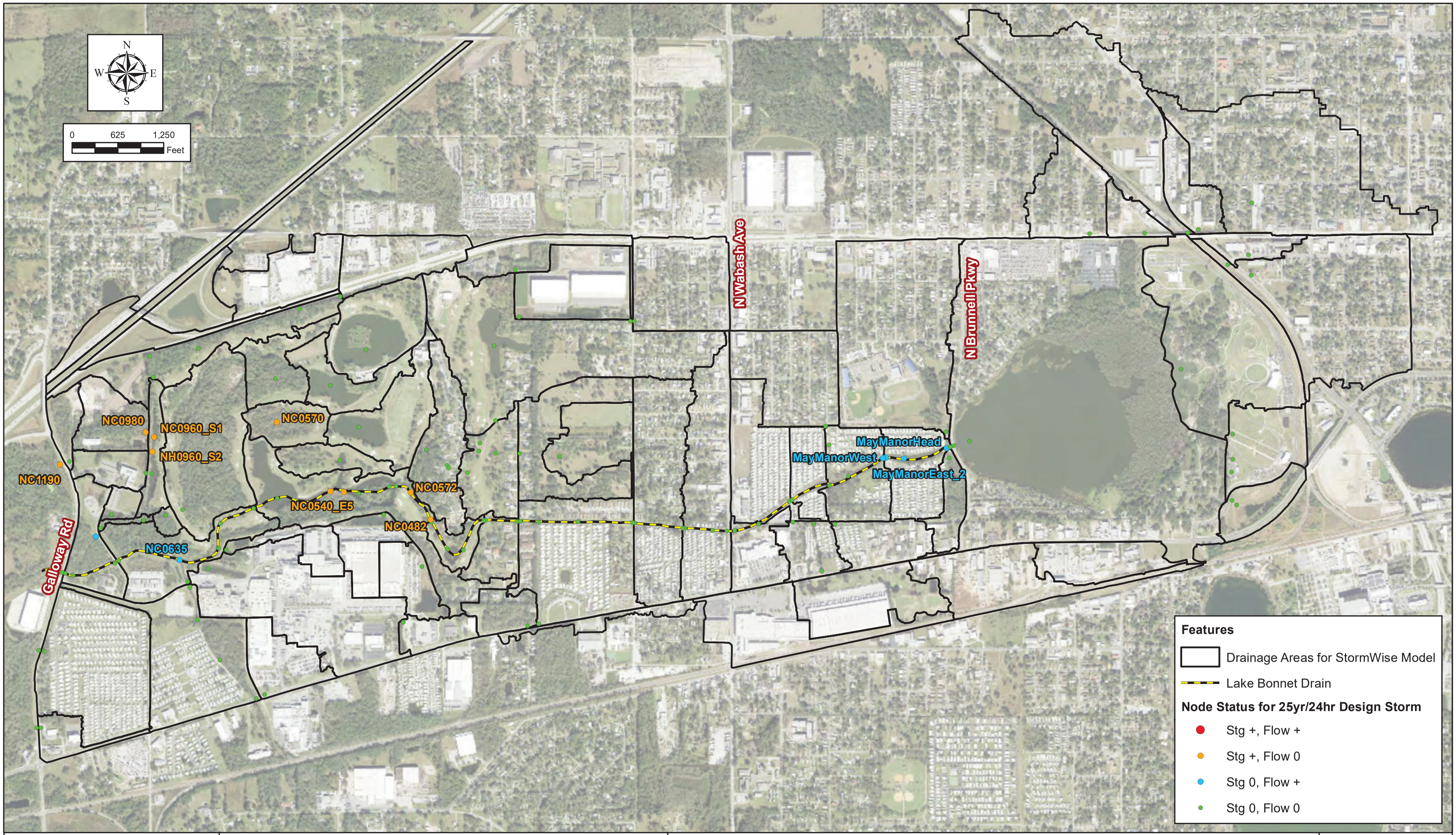
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - 10-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
46



AECOM

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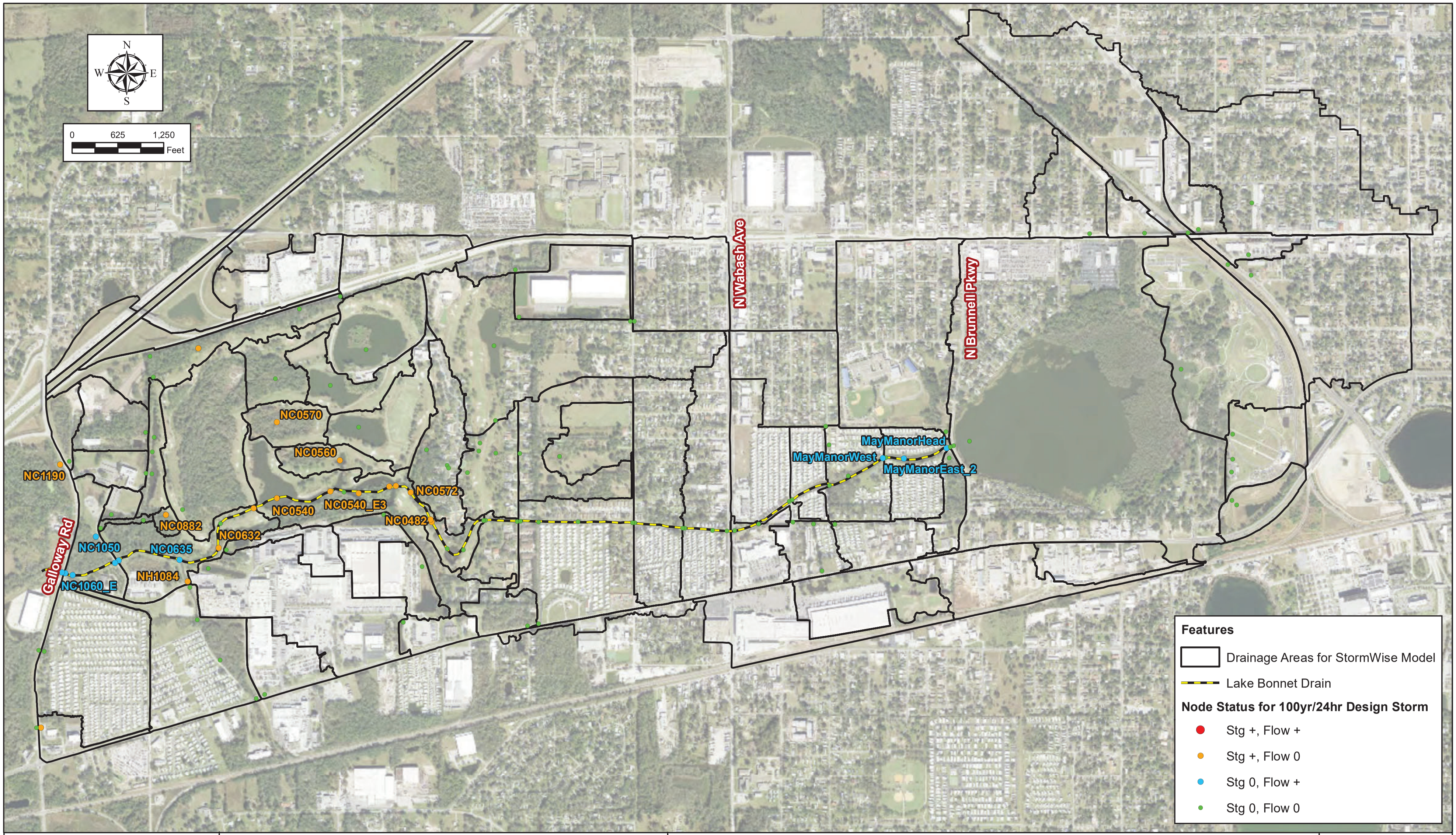
LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - 25-YEAR EVENT OFFSITE IMPACTS MAP

FIGURE
47



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LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
ALTERNATIVE 4 - 100-YEAR EVENT OFFSITE IMPACTS MAP

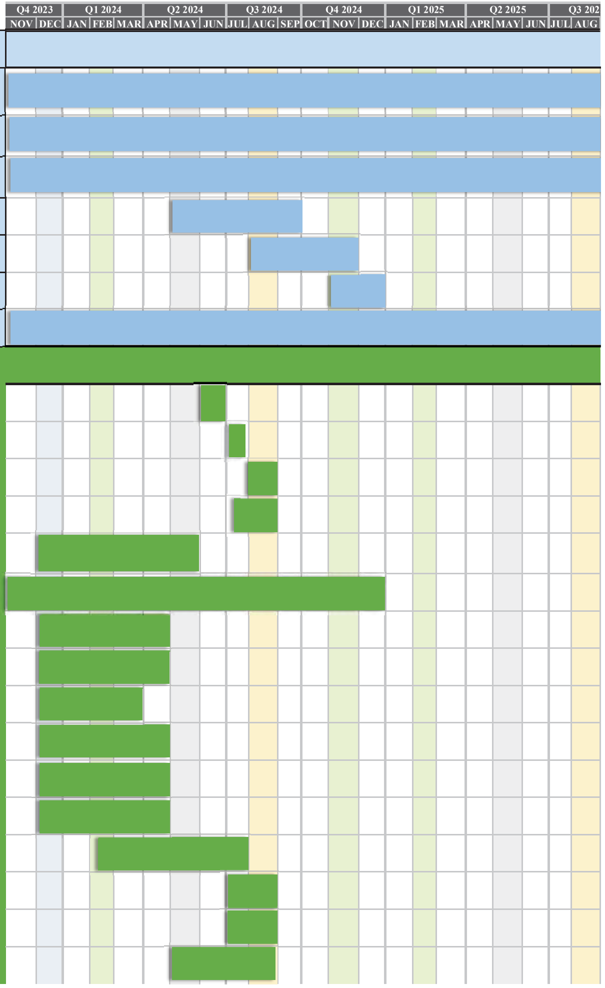
FIGURE 48

APPENDIX A

Project Schedule

Lake Bonnett Operations Schedule
Agreement# MT047
City of Lakeland, Florida

		Dates		Comments	Percent Complete
		Start	End		
Task 1 - Project Implementation					
1a	Financial records maintenance, preparation, and submittal of monthly and quarterly reports, HUD reports, SERA forms, and Audit reports	11/1/2022	Fri 10/29/28	AECOM Task started on 11/14/23. On track	11%
1b	Conduct stakeholder meetings (with property owners within the project area) and prepare meeting minutes. Provide community engagement and outreach activities,etc. through Phase 1, Phase 2, and Phase 3	Tue 12/01/23	Fri 10/29/28	On track	10%
1d	Monthly project planning meetings with City staff, vendors, subcontractors, and regulatory agencies, and preparation and submittal of meeting minutes to City and DOC through Phase 1, Phase 2, and Phase 3	Tue 12/1/22	Fri 10/29/28	AECOM Task started on 11/14/23. On track	11%
1e	Complete NEPA review (field investigations, records review, and site surveys)	Wed 6/1/24	Mon 12/30/24	Task not authorized	0%
1f	Prepare and submit NEPA/Findings and Recommendations Report **DRAFT**	Thu 9/1/24	Fri 11/29/24	Task not authorized	0%
1f	Prepare and submit NEPA/Findings and Recommendations Report **FINAL**	Fri 11/1/24	Tue 12/31/24	Task not authorized	0%
1g	Project Oversight and Program Management, communications with regulatory agencies, QA/QC oversight, compliance maintenance, etc.	Tue 11/14/23	Fri 10/29/28	On track	11%
Task 2 PHASE ONE - Feasibility Study					
2a	Complete Floodway Encroachment Analysis (field investigations, records review, site visits).	Fri 12/1/23	Fri 6/28/24		20%
2a	Prepare and submit DRAFT Floodway Encroachment Analysis Report with findings and recommendations.	Mon 4/1/24	Mon 7/22/24		10%
2a	Prepare and submit FINAL Floodway Encroachment Analysis Report with findings and recommendations.	Thu 5/1/24	Fri 8/30/24		5%
2b	Complete FEMA review and coordination, prepare Letter of Map Revision as needed.	Mon 12/1/23	Fri 8/30/24		0%
2c	Complete pre-application meetings with permitting agencies, including Southwest Florida Water Management District (SWFWMD), Florida Department of Environmental Protection (FDEP), US Army Corp of Engineers (USACoE).	Fri 12/1/23	2/28/2025	Need to extend end date to February, 2025	15%
2d	Stakeholder coordination with property owners within the Feasibility Study project area to obtain site access and review scope of work.	Tue 11/14/23	Tue 12/31/24	On track	10%
2e	Conduct surveys, site inspections, property records review, property appraisals, and land/easement acquisition study.	Fri 12/1/23	Wed 7/1/24	Deadline extended to 7/1/2024. No Action needed. This will not impact deliverable schedule.	85%
2f	Prepare and submit project technical scope, schedule, budget review and refinement. City will submit to DEO for approval.	Fri 12/1/23	Wed 4/30/24	Completed	100%
2g	Complete Topographic & Boundary Survey of project study area.	Fri 12/1/23	Mon 3/31/24	Field work completed. The data is being used by design team.	100%
2h	Complete Wetlands Delineation in project study area.	Fri 12/1/23	Wed 4/30/24	Field work completed. The data is being used by design team.	100%
2i	Complete Bathymetric Mapping and Sediment Thickness Survey	Fri 12/1/23	Wed 4/30/24	Completed	100%
2j	Complete LiDAR Survey of project study area.	Fri 12/1/23	Wed 4/30/24	Completed,	100%
2k	Complete Project Feasibility Study & Implementation Plan **DRAFT** report.	Wed 2/14/24	Wed 9/30/24	On track	60%
2k	Complete Project Feasibility Study & Implementation Plan **FINAL** report.	Mon 7/1/24	Fri 10/30/24		0%
2l	Complete and submit 15% Preliminary Design Report for Dredge Operations, Wetland Rehabilitation and Littoral Zone Restoration.	Mon 7/1/24	Wed 9/30/24		0%
2m	Complete and submit 15% Preliminary Design Report for Flood Protection Mitigation.	Wed 5/1/24	Wed 9/30/24	Start date moved to 7/1/2024. No Action needed. This will not impact deliverable schedule.	0%



April 2, 2024

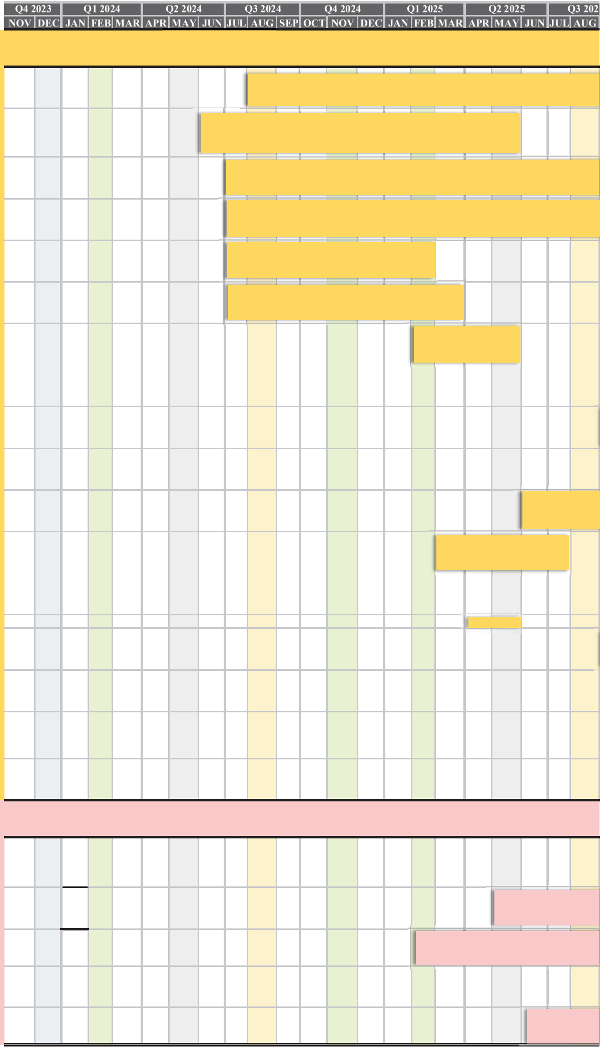
Lake Bonnett Operations Schedule
Agreement# MT047
City of Lakeland, Florida

		5	Q4 2025			Q1 2026			Q2 2026			Q3 2026			Q4 2026			Q1 2027			Q2 2027			Q3 2027			Q4 2027			Q1 2028			Q2 2028			Q3 2028			Q4 2028		
		SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Task 1 - Project Implementation																																									
1a	Financial records maintenance, preparation, and submittal of monthly and quarterly reports, HUD reports, SERA forms, and Audit reports	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
1b	Conduct stakeholder meetings (with property owners within the project area) and prepare meeting minutes. Provide community engagement and outreach activities,etc. through Phase 1, Phase 2, and Phase 3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
1d	Monthly project planning meetings with City staff, vendors, subcontractors, and regulatory agencies, and preparation and submittal of meeting minutes to City and DOC through Phase 1, Phase 2, and Phase 3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
1e	Complete NEPA review (field investigations, records review, and site surveys)																																								
1f	Prepare and submit NEPA/Findings and Recommendations Report **DRAFT**																																								
1f	Prepare and submit NEPA/Findings and Recommendations Report **FINAL**																																								
1g	Project Oversight and Program Management, communications with regulatory agencies, QA/QC oversight, compliance maintenance, etc.	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
Task 2 PHASE ONE - Feasibility Study																																									
2a	Complete Floodway Encroachment Analysis (field investigations, records review, site visits).																																								
2a	Prepare and submit DRAFT Floodway Encroachment Analysis Report with findings and recommendations.																																								
2a	Prepare and submit FINAL Floodway Encroachment Analysis Report with findings and recommendations.																																								
2b	Complete FEMA review and coordination, prepare Letter of Map Revision as needed.																																								
2c	Complete pre-application meetings with permitting agencies, including Southwest Florida Water Management District (SWFWMD), Florida Department of Environmental Protection (FDEP), US Army Corp of Engineers (USACoE).																																								
2d	Stakeholder coordination with property owners within the Feasibility Study project area to obtain site access and review scope of work.																																								
2e	Conduct surveys, site inspections, property records review, property appraisals, and land/easement acquisition study.																																								
2f	Prepare and submit project technical scope, schedule, budget review and refinement. City will submit to DEO for approval.																																								
2g	Complete Topographic & Boundary Survey of project study area.																																								
2h	Complete Wetlands Delineation in project study area.																																								
2i	Complete Bathymetric Mapping and Sediment Thickness Survey																																								
2j	Complete LiDAR Survey of project study area.																																								
2k	Complete Project Feasibility Study & Implementation Plan **DRAFT** report.																																								
2k	Complete Project Feasibility Study & Implementation Plan **FINAL** report.																																								
2l	Complete and submit 15% Preliminary Design Report for Dredge Operations, Wetland Rehabilitation and Littoral Zone Restoration.																																								
2m	Complete and submit 15% Preliminary Design Report for Flood Protection Mitigation.																																								

April 2, 2024

Lake Bonnett Operations Schedule
Agreement# MT047
City of Lakeland, Florida

		Dates		Comments	Percent Complete
		Start	End		
Task 3: PHASE TWO - Design and Engineering					0%
3a	Complete easement and property acquisition (budget includes sub-consultant time and $$ to purchase property)	11/1/2023	Fri 10/31/25	AECOM Task started on 08/01/24. On track	
3b	Complete Work Plans for field investigation work, including Health & Safety Plan, Emergency Response, Sampling & Analysis Plan, & Quality Assurance Project Plan.	6/3/2024	Fri 5/30/25		
3c	Complete sediment sampling field investigation, laboratory analysis, summary report.	Mon 7/1/24	Fri 11/28/25		
3d	Complete geotechnical field investigation, laboratory, laboratory analysis, summary report.	Mon 7/1/24	Fri 2/27/26		
3e	Complete Groundwater Impact Field Investigation (monitoring well and seepage meter install, sampling and analysis) and Report.	Mon 7/1/24	Fri 2/28/25		
3f	Complete treatability testing/evaluation, and summary report.	Mon 7/1/24	Fri 3/28/25		
3g	Complete Construction Design Plans (60%) for Dredge Operations, Wetland Restoration, and Littoral Zone Rehabilitation.	Mon 2/3/25	Fri 5/30/25		
3h	Complete Construction Design Plans (90%) for Dredge Operations, Wetland Restoration, and Littoral Zone Rehabilitation.	Mon 9/1/25	Fri 11/28/25		
3i	Complete Construction Design Plans (100%) for Dredge Operations, Wetland Restoration, and Littoral Zone Rehabilitation.	Mon 12/1/25	Fri 1/30/26		
3j	Complete Value Engineering & Constructability Review and Summary Report.	Mon 8/1/24	Tue 9/30/25		
3k	State, Local, and Federal Permit application and submittals (SWFWMD, FDEP and USACoE).	7/1/2024	Thu 7/31/25	AECOM Task starts on 3/3/25	
3l	Complete Construction Design Plans (60%) for Flood Protection Mitigation	Tue 9/15/24	Fri 2/28/25		
3m	Complete Construction Design Plans (90%) for Flood Protection Mitigation	Mon 9/1/25	Fri 11/28/25		
3n	Complete Construction Design Plans (100%) for Flood Protection Mitigation	Mon 12/1/25	Thu 1/29/26		
3o	Complete Construction Design and Bid Specification Package for Dredge Operations, Wetland Restoration, and Littoral Zone Rehabilitation, and submit to DEO for review and approval.	Mon 2/2/26	Tue 3/31/26		
3p	Complete Construction Design and Bid Specification Package for Flood Protection Mitigation, and submit to DEO for review and approval.	Mon 2/2/26	Tue 3/31/26		
Task 4: PHASE 3 - Construction					
4a	Complete procurement package and submit to DOC for approval. Advertise Construction bids for dredging operations and sediment management, subcontractor site visit, bid review, bid award & notification to most responsive bidder(s).	Mon 3/2/26	Tue 4/28/26		
4b	Construction Management & Vendor/Subcontractor Oversight, monthly project status reviews/updates as outlined in DEO Agreement No. MT047 throughout Phase 3.	Thu 5/1/25	Tue 10/31/28		
4c	Complete construction oversight workplans (Health & Safety, Emergency Reponse & Preparedness).	Sat 2/1/25	Tue 3/31/26		
4m	Complete procurement package and submit to DOC for approval. Advertise Construction bids for flood protection mitigation (weir removal, embankment stabilization, pump station construction, culvert retrofits, canal modification, and flood relief diversion infrastructure)	Sun 3/1/26	Thu 4/30/26		
4v	Final Report delivery including as-built engineering drawings and photo documentation.	Sun 6/1/25	Fri 6/30/28		



April 2, 2024

Lake Bonnett Operations Schedule
Agreement# MT047
City of Lakeland, Florida

		5	Q4 2025			Q1 2026			Q2 2026			Q3 2026			Q4 2026			Q1 2027			Q2 2027			Q3 2027			Q4 2027			Q1 2028			Q2 2028			Q3 2028			Q4 2028		
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4v	Final Report delivery including as-built engineering drawings and photo documentation.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						

April 2, 2024

APPENDIX B

MODEL RESULTS NODE STAGE AND FLOW SUMMARY

APPENDIX B1

Existing Condition Model Results

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.50	15.589	25.11	26.50
BridgeBlvdDS	141.38	15.175	77.89	16.00
BridgeBlvdUS	141.46	15.450	66.41	12.50
BrunnellDS	141.50	15.589	25.11	26.50
ChestnutDS	136.41	14.237	136.64	14.25
ChestnutUS	140.87	14.245	136.59	14.25
Downstream TW	123.04	33.667	355.51	23.25
GolfcartDS	129.20	14.365	167.27	14.25
GolfcartUS	129.37	14.330	167.45	14.25
HowardDS	129.52	14.324	164.54	14.25
HowardUS	129.60	14.330	164.59	14.00
LAGOON	145.45	26.369	78.45	15.00
Lake Blanton_West	128.68	14.448	166.52	14.50
Lake bonnet	145.45	26.408	475.44	12.50
LakeBlanton_East	128.70	14.442	167.12	14.25
MayManorEast	141.48	15.540	43.56	16.75
MayManorEast_2	141.48	15.552	39.42	16.75
MayManorHead	141.49	15.540	39.07	16.50
MayManorWest	141.47	15.502	44.19	17.25
MHPWEIRDS	141.25	14.816	86.25	15.75
MHPWeirUS	141.31	14.879	86.14	15.75
NC0020	195.94	15.553	22.96	15.50
NC0040	192.66	15.515	24.23	15.50
NC0060	199.74	12.462	17.19	12.50
NC0080	198.51	14.286	31.11	14.25
NC0090	187.43	15.056	56.32	15.00
NC0100	190.79	15.881	17.23	15.50
NC0120S	188.07	27.117	3.96	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.05	0.000	0.00	0.00
NC0120Sd	185.51	13.161	0.67	13.00
NC0140	168.93	12.637	17.97	12.50
NC0160	204.29	12.201	14.44	12.25
NC0180	196.05	12.484	34.18	12.50
NC0200	158.79	12.593	31.94	12.50
NC0240	142.43	15.741	23.51	15.50
NC0260	142.01	14.646	8.35	12.75
NC0300	149.66	13.456	16.23	13.50
NC0360	151.28	14.421	12.40	14.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0365	147.84	14.530	12.29	14.50
NC0370	148.17	12.428	21.10	12.50
NC0380	144.29	12.382	39.52	12.50
NC0382	142.64	12.392	39.69	12.50
NC0390	152.24	12.838	27.59	12.75
NC0398	141.14	14.526	98.73	15.00
NC0430	134.51	18.032	6.14	12.75
NC0440	134.50	18.267	11.11	13.00
NC0442	134.37	18.510	2.85	17.75
NC0460	131.79	14.089	163.65	14.00
NC0462	130.60	14.182	164.72	14.00
NC0480	127.75	14.459	167.62	14.50
NC0482	125.83	14.454	167.64	14.50
NC0500	132.47	13.713	5.86	13.50
NC0510	132.29	12.952	26.40	12.00
NC0520	129.87	13.201	36.55	12.25
NC0540	123.98	24.292	143.98	15.25
NC0540_E1	123.99	24.317	167.31	14.50
NC0540_E2	123.99	24.317	311.58	15.50
NC0540_E3	123.99	24.276	167.98	15.75
NC0540_E4	123.98	24.271	139.98	15.25
NC0540_E5	123.98	24.330	135.78	15.50
NC0560	123.98	24.405	6.17	16.25
NC0570	124.13	30.904	20.14	22.50
NC0572	124.18	18.931	167.66	14.50
NC0590	123.91	24.855	108.24	16.50
NC0620	126.13	16.089	3.65	15.75
NC0630	126.34	12.450	87.94	12.25
NC0631	123.90	24.951	107.39	16.50
NC0632	123.89	25.142	109.25	16.50
NC0635	123.89	34.776	466.76	16.75
NC0640	123.82	34.957	455.34	17.50
NC0650	123.75	34.899	445.34	18.00
NC0660	148.01	12.305	30.57	12.25
NC0670	137.50	13.110	30.46	12.25
NC0680	131.18	0.000	10.67	12.75
NC0700	128.00	13.085	13.87	13.00
NC0720	127.25	24.846	92.91	13.25
NC0722	127.19	24.251	27.20	13.25
NC0740	132.41	13.126	15.08	12.75

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0760	128.74	13.138	27.79	13.00
NC0780	127.16	13.148	37.64	13.00
NC0781	127.08	13.157	9.49	13.25
NC0782	126.88	13.159	9.50	13.25
NC0783	126.03	13.180	9.53	13.25
NC0784	125.04	23.810	9.55	13.25
NC0785	124.97	23.768	9.56	13.25
NC0787	124.89	23.746	28.56	12.50
NC0800	124.72	24.240	29.61	12.50
NC0820	123.24	60.327	11.24	14.75
NC0840	123.24	58.969	16.20	0.25
NC0860	123.24	58.617	16.14	12.25
NC0880	123.25	58.388	25.83	16.75
NC0882	123.70	35.310	16.82	17.50
NC0900	130.16	12.638	24.46	12.50
NC0912	129.67	12.787	23.67	12.75
NC0920	129.97	14.642	44.36	12.25
NC0925	129.29	13.354	34.08	12.75
NC0930	132.61	19.556	6.87	13.50
NC0935	129.97	14.653	25.86	12.25
NC0937	126.22	13.557	28.39	13.25
NC0940	134.47	15.675	1.88	13.25
NC0950	131.04	12.314	14.61	12.25
NC0955	125.72	12.338	14.16	12.25
NC0960	124.41	13.832	42.95	13.25
NC0960_S1	123.71	35.367	46.00	13.50
NC0960_S2	123.71	35.338	37.45	13.50
NC0980	124.31	13.917	3.91	14.00
NC1000	123.77	12.201	16.86	12.25
NC1020	123.71	35.342	63.51	13.00
NC1030	123.71	35.308	37.98	15.25
NC1035	123.72	12.129	8.05	12.00
NC1040	123.71	35.315	43.68	15.25
NC1050	123.71	34.970	57.09	15.00
NC1060	123.59	35.098	430.07	19.75
NC1060_E	123.72	34.975	442.26	18.00
NC1070	123.52	35.140	429.92	19.75
NC1180	126.56	17.719	6.52	12.50
NC1190	123.47	35.049	0.70	17.50
NC1200	123.47	35.049	7.88	17.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1210	123.47	34.794	429.46	19.75
NC1220	123.25	35.152	66.38	12.50
NC1230	123.25	34.928	66.07	12.50
NC1360	123.25	34.693	420.35	20.00
NC1362	123.04	34.023	387.77	20.00
NC1380	123.85	13.584	5.07	13.50
NC1382	123.21	14.606	5.05	13.50
NH1042	127.53	17.167	0.00	0.00
NH1044	127.30	17.203	343.29	17.00
NH1060	126.56	17.449	343.26	17.00
NH1060_SA	128.66	12.505	27.28	12.25
NH1080	124.14	24.575	355.11	16.75
NH1082	124.02	24.589	353.61	17.00
NH1084	123.91	24.880	352.63	17.00
SterlingCanal	141.47	15.525	93.09	12.50
SterlingCanal_East	141.47	15.500	63.45	12.50
SterlingCanal_N	142.50	13.499	16.23	13.50
WabashDS	141.19	14.584	98.69	15.00
WabashUS	141.21	14.622	88.41	15.75
WoodallDS	140.92	14.334	117.28	14.50
WoodallUS	141.07	14.430	117.22	14.50

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.26	15.771	60.86	25.00
BridgeBlvdDS	142.10	15.177	137.59	16.00
BridgeBlvdUS	142.18	15.469	115.19	16.50
BrunnellDS	142.23	15.577	60.86	25.00
ChestnutDS	137.56	14.092	234.61	14.00
ChestnutUS	141.01	14.087	234.96	14.00
Downstream TW	124.10	42.167	546.07	36.75
GolfcartDS	130.02	14.405	281.05	14.25
GolfcartUS	130.33	14.383	282.78	14.25
HowardDS	130.44	14.359	281.36	14.00
HowardUS	130.58	14.296	281.59	14.00
LAGOON	146.07	24.985	142.09	14.50
Lake Blanton_West	129.43	14.456	280.87	14.50
Lake bonnet	146.07	24.996	756.60	12.50
LakeBlanton_East	129.45	14.461	280.80	14.25
MayManorEast	142.20	15.460	92.55	19.00
MayManorEast_2	142.20	15.477	82.08	19.75
MayManorHead	142.22	15.524	81.65	19.75
MayManorWest	142.19	15.453	87.56	18.00
MHPWEIRDS	141.89	14.845	150.60	15.50
MHPWeirUS	141.98	14.940	150.47	15.50
NC0020	196.68	15.437	39.61	15.50
NC0040	193.42	15.393	41.50	15.50
NC0060	204.02	14.083	27.51	12.50
NC0080	203.50	14.387	52.18	14.25
NC0090	188.69	14.818	103.76	14.75
NC0100	192.52	16.907	31.46	15.25
NC0120S	189.14	27.117	10.88	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.26	12.565	0.03	12.50
NC0120Sd	186.26	12.542	5.87	12.50
NC0140	169.65	12.632	28.99	12.50
NC0160	204.53	12.196	22.17	12.25
NC0180	199.08	12.508	53.40	12.50
NC0200	163.56	12.824	51.23	12.50
NC0240	142.67	15.566	38.87	15.50
NC0260	142.84	14.930	13.08	12.75
NC0300	150.15	13.420	27.93	13.50
NC0360	151.48	14.343	20.20	14.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0365	148.16	14.427	20.07	14.25
NC0370	148.49	12.414	32.34	12.50
NC0380	145.20	12.436	65.25	12.50
NC0382	144.75	12.441	65.74	12.50
NC0390	153.12	12.806	44.30	12.75
NC0398	141.68	14.054	170.39	15.00
NC0430	134.97	17.371	9.59	12.75
NC0440	134.95	18.038	17.03	13.00
NC0442	134.59	18.305	4.67	17.50
NC0460	132.90	13.938	279.21	13.75
NC0462	131.55	14.116	281.75	14.00
NC0480	128.32	14.462	283.15	14.50
NC0482	126.82	14.524	283.16	14.50
NC0500	132.99	13.983	8.98	13.25
NC0510	132.67	13.203	41.12	12.00
NC0520	130.18	12.716	54.24	12.25
NC0540	125.23	37.571	261.56	15.50
NC0540_E1	125.24	37.400	282.47	14.50
NC0540_E2	125.24	37.400	511.84	15.25
NC0540_E3	125.24	37.400	258.83	14.75
NC0540_E4	125.23	37.374	253.35	15.25
NC0540_E5	125.23	37.297	249.24	15.50
NC0560	125.23	38.114	11.48	14.75
NC0570	125.23	37.509	88.31	17.25
NC0572	125.25	37.354	283.14	14.50
NC0590	125.18	37.259	199.73	15.50
NC0620	126.32	16.479	5.36	15.75
NC0630	126.53	12.406	135.17	12.25
NC0631	125.18	37.258	198.26	15.50
NC0632	125.17	37.175	200.24	15.50
NC0635	125.17	37.195	643.90	16.00
NC0640	125.12	37.379	633.63	18.75
NC0650	124.93	37.894	624.46	19.00
NC0660	150.18	12.380	59.23	12.25
NC0670	137.77	12.452	55.89	12.50
NC0680	131.18	0.000	18.44	12.75
NC0700	129.13	24.479	25.85	13.00
NC0720	129.13	24.510	171.89	12.75
NC0722	128.89	23.193	37.05	13.00
NC0740	132.69	13.022	26.05	12.75

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0760	130.24	13.288	51.38	13.00
NC0780	129.73	13.645	69.74	13.00
NC0781	129.38	13.606	21.15	13.75
NC0782	128.85	13.530	21.16	13.75
NC0783	127.57	13.202	21.16	13.75
NC0784	127.26	13.090	21.19	14.00
NC0785	127.13	13.041	21.20	14.00
NC0787	126.81	12.913	54.73	12.50
NC0800	125.24	37.523	55.20	13.00
NC0820	123.85	64.240	19.14	14.75
NC0840	123.85	63.150	16.20	0.25
NC0860	123.85	62.907	29.68	12.25
NC0880	123.85	62.823	37.87	16.00
NC0882	124.89	38.476	22.87	15.50
NC0900	130.31	12.635	38.34	12.50
NC0912	129.99	12.752	37.13	12.50
NC0920	130.47	15.032	41.66	12.00
NC0925	129.54	13.374	49.23	12.75
NC0930	132.85	18.362	11.06	13.50
NC0935	130.47	15.043	45.58	12.25
NC0937	126.37	13.622	41.45	13.50
NC0940	134.75	15.194	4.43	13.00
NC0950	131.06	12.297	23.09	12.25
NC0955	125.85	12.264	22.97	12.25
NC0960	124.90	38.557	69.15	13.25
NC0960_S1	124.89	38.524	75.23	13.50
NC0960_S2	124.89	38.647	62.53	13.50
NC0980	124.89	38.653	8.10	13.75
NC1000	124.89	38.605	25.69	12.25
NC1020	124.89	38.506	85.05	12.50
NC1030	124.89	38.476	37.71	12.75
NC1035	124.90	38.629	12.27	12.00
NC1040	124.90	38.433	43.21	12.75
NC1050	124.90	38.126	59.49	13.75
NC1060	124.81	38.503	614.25	19.75
NC1060_E	124.90	38.143	622.00	19.00
NC1070	124.64	39.202	613.59	19.75
NC1180	126.81	16.119	11.39	12.50
NC1190	124.57	39.608	1.64	15.75
NC1200	124.57	39.608	17.46	15.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1210	124.57	39.530	612.98	19.75
NC1220	124.35	41.129	103.01	12.50
NC1230	124.35	40.913	96.18	12.75
NC1360	124.35	40.721	602.27	20.00
NC1362	124.10	42.187	570.16	21.25
NC1380	124.21	13.618	7.73	13.50
NC1382	124.10	42.541	7.66	13.50
NH1042	128.51	34.667	0.00	0.00
NH1044	128.26	34.700	536.39	34.75
NH1060	127.38	34.848	536.47	34.75
NH1060_SA	129.28	12.653	43.47	12.25
NH1080	125.49	36.226	536.43	34.75
NH1082	125.37	36.500	535.82	34.75
NH1084	125.20	37.135	535.56	34.75
SterlingCanal	142.19	15.468	122.59	12.50
SterlingCanal_East	142.19	15.458	89.58	17.50
SterlingCanal_N	143.01	13.537	27.94	13.50
WabashDS	141.76	14.048	170.34	15.00
WabashUS	141.83	14.707	154.01	15.50
WoodallDS	141.15	14.092	199.71	14.50
WoodallUS	141.58	14.072	200.48	14.00

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.70	15.958	86.29	24.75
BridgeBlvdDS	142.54	15.410	181.11	16.50
BridgeBlvdUS	142.59	15.495	155.32	17.25
BrunnellDS	142.65	15.658	86.29	24.75
ChestnutDS	138.05	13.937	290.92	14.00
ChestnutUS	141.08	13.960	290.86	13.75
Downstream TW	124.93	41.167	764.00	34.75
GolfcartDS	130.40	14.579	346.20	14.50
GolfcartUS	130.80	14.556	348.49	14.25
HowardDS	130.87	14.532	348.64	13.75
HowardUS	131.04	14.458	349.52	13.75
LAGOON	146.42	24.619	176.85	14.25
Lake Blanton_West	129.78	14.632	345.77	14.50
Lake bonnet	146.41	24.627	927.04	12.50
LakeBlanton_East	129.80	14.631	346.12	14.50
MayManorEast	142.61	15.543	120.35	21.50
MayManorEast_2	142.61	15.543	111.87	20.00
MayManorHead	142.64	15.583	111.27	20.50
MayManorWest	142.60	15.506	119.12	17.75
MHPWEIRDS	142.30	15.150	194.51	16.00
MHPWeirUS	142.41	15.205	194.30	16.00
NC0020	197.09	15.413	49.84	15.50
NC0040	193.85	15.333	52.16	15.25
NC0060	204.40	13.090	33.67	12.50
NC0080	203.62	14.220	65.13	14.25
NC0090	189.24	14.788	126.30	14.75
NC0100	193.81	18.033	40.40	15.25
NC0120S	189.78	27.117	15.78	12.50
NC0120Sa	186.72	12.578	0.04	12.50
NC0120Sb	186.73	12.507	0.05	12.50
NC0120Sc	186.73	12.500	0.34	12.25
NC0120Sd	186.73	12.493	11.01	12.50
NC0140	170.29	12.653	35.59	12.50
NC0160	204.60	12.186	26.77	12.25
NC0180	199.16	12.495	65.12	12.50
NC0200	163.82	12.612	62.75	12.50
NC0240	142.75	15.561	48.19	15.50
NC0260	142.95	14.100	15.90	12.75
NC0300	150.40	13.405	35.10	13.50
NC0360	151.59	14.316	24.91	14.00

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0365	148.31	14.392	24.80	14.25
NC0370	148.65	12.418	39.03	12.50
NC0380	145.42	12.402	79.40	12.50
NC0382	144.91	12.418	79.93	12.50
NC0390	153.16	12.751	54.29	12.75
NC0398	141.98	14.547	216.89	15.25
NC0430	135.19	16.366	11.65	12.75
NC0440	135.15	17.795	20.42	13.25
NC0442	134.72	18.065	6.05	17.50
NC0460	133.41	13.800	347.33	13.75
NC0462	131.97	14.099	350.42	13.75
NC0480	128.60	14.618	348.89	14.50
NC0482	127.30	14.734	348.85	14.50
NC0500	133.18	13.981	10.86	13.25
NC0510	132.78	12.822	49.86	12.00
NC0520	130.36	12.710	65.32	12.00
NC0540	126.16	35.844	341.41	15.25
NC0540_E1	126.17	35.889	348.64	14.75
NC0540_E2	126.17	35.821	607.49	15.25
NC0540_E3	126.17	35.821	351.60	14.75
NC0540_E4	126.16	35.841	327.89	15.25
NC0540_E5	126.16	35.842	324.71	15.25
NC0560	126.16	36.744	14.21	14.50
NC0570	126.16	35.809	163.37	15.75
NC0572	126.17	35.774	348.83	14.75
NC0590	126.10	35.710	253.58	18.50
NC0620	126.42	16.656	6.39	15.75
NC0630	126.62	12.394	163.27	12.25
NC0631	126.10	35.728	252.37	18.75
NC0632	126.09	35.733	255.22	18.75
NC0635	126.09	35.737	845.50	32.50
NC0640	126.05	35.841	838.72	32.75
NC0650	125.94	36.298	835.10	33.00
NC0660	150.36	12.282	77.38	12.25
NC0670	137.79	12.228	77.10	12.25
NC0680	131.18	0.000	23.18	12.75
NC0700	130.11	24.469	33.38	13.00
NC0720	130.10	24.462	248.65	13.00
NC0722	130.09	24.368	38.81	12.75
NC0740	132.82	12.986	32.74	12.75

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0760	130.34	13.036	65.96	13.00
NC0780	130.12	13.109	92.16	12.75
NC0781	129.89	13.079	21.80	26.00
NC0782	129.52	13.049	21.80	26.00
NC0783	128.55	12.999	21.80	26.00
NC0784	128.30	12.981	21.80	26.00
NC0785	128.19	12.984	21.80	25.75
NC0787	127.91	12.969	68.12	12.25
NC0800	126.17	35.812	65.44	13.00
NC0820	124.24	66.846	23.64	14.75
NC0840	124.24	65.806	19.01	13.75
NC0860	124.24	65.675	38.10	12.25
NC0880	124.24	65.590	45.96	15.75
NC0882	125.90	36.495	26.82	15.00
NC0900	130.38	12.624	46.60	12.50
NC0912	130.15	12.736	45.27	12.50
NC0920	130.72	15.105	49.87	12.50
NC0925	129.67	13.351	58.76	12.75
NC0930	132.97	17.941	13.57	13.50
NC0935	130.72	15.115	56.07	12.25
NC0937	126.46	13.573	50.44	13.50
NC0940	134.90	15.102	6.20	13.00
NC0950	131.07	12.294	28.23	12.25
NC0955	125.91	36.610	28.11	12.25
NC0960	125.91	36.576	86.28	13.50
NC0960_S1	125.90	36.504	94.27	13.50
NC0960_S2	125.90	36.602	79.97	13.75
NC0980	125.90	36.504	10.86	13.75
NC1000	125.90	36.662	30.94	12.25
NC1020	125.90	36.536	92.66	12.50
NC1030	125.90	36.494	42.41	14.75
NC1035	125.91	36.579	14.78	12.00
NC1040	125.91	36.502	45.63	12.50
NC1050	125.91	36.413	64.01	13.75
NC1060	125.85	36.607	792.55	34.00
NC1060_E	125.91	36.433	833.52	33.00
NC1070	125.52	37.683	790.40	34.00
NC1180	126.95	15.862	14.36	12.50
NC1190	125.44	38.140	2.33	15.75
NC1200	125.44	38.140	23.50	14.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1210	125.44	38.191	789.78	34.00
NC1220	125.23	39.718	124.80	12.50
NC1230	125.23	39.474	108.12	12.75
NC1360	125.23	39.316	784.37	34.25
NC1362	124.94	41.336	771.93	34.75
NC1380	124.93	42.003	9.32	13.50
NC1382	124.93	41.742	9.81	21.00
NH1042	129.23	32.417	0.00	0.00
NH1044	128.93	32.462	752.44	32.25
NH1060	128.05	32.743	752.26	32.25
NH1060_SA	129.52	12.745	53.12	12.25
NH1080	126.56	34.239	752.18	32.50
NH1082	126.44	34.513	751.29	32.50
NH1084	126.12	35.633	750.99	32.50
SterlingCanal	142.59	15.529	149.36	15.50
SterlingCanal_East	142.60	15.515	122.90	17.75
SterlingCanal_N	143.28	13.556	35.11	13.50
WabashDS	142.09	14.544	216.87	15.25
WabashUS	142.20	14.546	198.19	15.75
WoodallDS	141.28	14.539	253.31	14.50
WoodallUS	141.87	14.554	253.53	14.50

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	143.77	16.900	154.26	24.25
BridgeBlvdDS	143.44	16.056	285.01	17.00
BridgeBlvdUS	143.46	16.055	251.31	17.75
BrunnellDS	143.55	16.265	154.27	24.25
ChestnutDS	139.20	13.855	436.39	13.75
ChestnutUS	141.24	13.865	436.91	13.75
Downstream TW	126.05	38.167	1279.96	30.00
GolfcartDS	131.18	14.936	501.72	15.00
GolfcartUS	131.86	14.924	506.46	14.50
HowardDS	131.89	14.910	512.28	14.00
HowardUS	132.32	14.762	518.87	13.75
LAGOON	147.18	24.155	287.47	12.75
Lake Blanton_West	130.48	14.995	501.78	15.00
Lake bonnet	147.18	24.163	1351.02	12.50
LakeBlanton_East	130.49	14.994	501.77	15.00
MayManorEast	143.48	16.084	214.32	17.75
MayManorEast_2	143.49	16.076	197.13	20.50
MayManorHead	143.52	16.168	195.42	20.50
MayManorWest	143.47	16.079	207.46	18.00
MHPWEIRDS	143.11	15.695	300.86	16.50
MHPWeirUS	143.23	15.712	300.55	16.50
NC0020	201.49	16.138	75.77	15.25
NC0040	196.16	18.156	76.04	16.00
NC0060	204.66	12.601	48.95	12.50
NC0080	203.80	14.186	96.21	14.25
NC0090	190.38	14.542	172.47	14.50
NC0100	196.17	18.178	71.25	15.25
NC0120S	191.36	27.117	29.88	12.25
NC0120Sa	188.12	12.471	0.58	12.25
NC0120Sb	188.12	12.460	1.38	12.25
NC0120Sc	188.12	12.453	1.97	12.25
NC0120Sd	188.12	12.449	28.09	12.50
NC0140	174.63	12.638	51.96	12.50
NC0160	204.73	12.173	38.17	12.25
NC0180	199.28	12.487	94.23	12.50
NC0200	163.91	12.571	91.34	12.50
NC0240	143.53	16.169	71.56	15.50
NC0260	143.52	16.170	22.89	12.75
NC0300	150.99	13.385	53.09	13.50
NC0360	152.13	14.662	36.72	14.00

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0365	148.60	14.728	35.26	14.75
NC0370	148.94	12.427	55.62	12.50
NC0380	145.84	12.431	115.08	12.50
NC0382	145.17	12.456	116.08	12.50
NC0390	153.26	12.762	79.11	12.75
NC0398	142.50	15.346	331.70	15.50
NC0430	135.78	14.405	16.75	12.75
NC0440	135.37	16.493	27.24	13.25
NC0442	135.23	16.697	13.19	16.25
NC0460	134.70	13.788	519.05	13.75
NC0462	132.63	14.606	523.08	13.75
NC0480	129.11	15.024	506.95	15.00
NC0482	128.32	15.919	506.95	15.00
NC0500	133.49	13.987	15.51	13.25
NC0510	132.89	12.413	71.53	12.00
NC0520	130.59	12.389	114.95	12.25
NC0540	127.41	30.392	497.67	18.00
NC0540_E1	127.42	30.290	505.53	15.00
NC0540_E2	127.42	30.263	628.71	21.25
NC0540_E3	127.42	30.297	491.55	16.50
NC0540_E4	127.42	30.320	469.98	15.75
NC0540_E5	127.41	30.320	460.65	16.00
NC0560	127.41	30.714	26.19	12.75
NC0570	127.41	30.287	275.15	14.00
NC0572	127.42	30.279	506.81	15.00
NC0590	127.34	30.820	472.91	18.25
NC0620	127.36	30.747	8.96	15.75
NC0630	127.33	31.243	232.95	12.25
NC0631	127.34	30.818	470.61	18.25
NC0632	127.33	31.020	472.58	18.25
NC0635	127.33	31.015	1354.77	29.00
NC0640	127.29	31.150	1351.32	29.00
NC0650	127.24	31.329	1349.32	29.00
NC0660	150.56	12.267	123.90	12.25
NC0670	137.88	12.339	123.75	12.25
NC0680	131.18	0.000	35.06	12.75
NC0700	131.09	17.456	73.25	14.75
NC0720	131.09	17.459	419.37	12.75
NC0722	131.09	17.457	36.59	12.50
NC0740	133.08	12.893	49.51	12.75

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0760	131.09	17.449	103.05	13.00
NC0780	131.08	17.456	148.95	12.75
NC0781	131.04	17.844	18.33	33.25
NC0782	130.97	18.136	18.34	33.50
NC0783	130.81	18.347	18.34	33.50
NC0784	130.77	18.398	18.34	33.50
NC0785	130.75	18.401	18.34	33.25
NC0787	130.71	18.445	112.58	17.25
NC0800	127.42	30.289	111.65	18.50
NC0820	124.92	67.663	33.99	14.75
NC0840	124.92	66.686	28.04	13.50
NC0860	124.92	66.573	59.42	12.25
NC0880	124.92	66.508	70.57	16.75
NC0882	127.19	31.513	34.77	13.75
NC0900	130.56	12.710	67.10	12.50
NC0912	130.46	12.746	64.20	12.50
NC0920	131.23	15.249	72.58	12.50
NC0925	129.91	13.297	82.07	12.75
NC0930	133.23	17.450	19.82	13.50
NC0935	131.24	15.258	80.11	12.25
NC0937	127.20	31.444	74.28	13.25
NC0940	135.23	15.066	11.01	13.00
NC0950	131.09	12.292	41.27	12.25
NC0955	127.20	31.565	41.13	12.25
NC0960	127.20	31.541	134.85	13.25
NC0960_S1	127.20	31.531	143.54	13.75
NC0960_S2	127.20	31.393	128.65	13.75
NC0980	127.20	31.532	18.14	13.75
NC1000	127.20	31.681	43.98	12.25
NC1020	127.20	31.504	135.63	13.75
NC1030	127.20	31.415	64.71	16.75
NC1035	127.20	31.571	21.00	12.00
NC1040	127.20	31.382	82.48	16.75
NC1050	127.20	31.383	95.67	16.75
NC1060	127.16	31.553	1329.99	29.50
NC1060_E	127.20	31.383	1348.84	29.25
NC1070	126.86	32.599	1328.74	29.75
NC1180	127.29	15.469	21.82	12.50
NC1190	126.77	32.885	4.19	15.50
NC1200	126.77	32.884	37.17	13.25

Lake Bonnet Drain

Existing Condition Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1210	126.77	32.976	1327.81	29.75
NC1220	126.46	35.243	178.85	12.50
NC1230	126.50	34.705	123.77	13.00
NC1360	126.50	34.698	1320.12	29.75
NC1362	126.05	38.160	1293.45	29.75
NC1380	126.43	35.375	22.16	13.00
NC1382	126.05	38.208	20.63	22.25
NH1042	130.29	29.917	0.00	0.00
NH1044	129.93	30.180	1121.89	29.75
NH1060	129.07	30.215	1121.67	30.00
NH1060_SA	130.00	12.953	77.03	12.25
NH1080	127.96	30.393	1122.78	30.00
NH1082	127.83	30.522	1122.63	30.25
NH1084	127.36	31.013	1122.58	30.25
SterlingCanal	143.47	16.081	243.73	17.50
SterlingCanal_East	143.47	16.091	211.55	19.25
SterlingCanal_N	143.90	13.641	53.11	13.50
WabashDS	142.69	15.529	331.74	15.50
WabashUS	142.98	15.635	305.42	16.50
WoodallDS	141.60	14.189	376.05	14.50
WoodallUS	142.36	14.471	376.07	14.50

APPENDIX B2

Alternative 1 Model Results

Lake Bonnet Drain
Alternative 1 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.78	13.679	25.12	26.50
BridgeBlvdDS	141.64	13.574	98.25	14.00
BridgeBlvdUS	141.75	13.687	74.11	14.50
BrunnellDS	141.78	13.699	25.12	26.25
ChestnutDS	137.16	13.534	195.18	13.50
ChestnutUS	140.96	13.512	195.27	13.50
Downstream TW	123.04	33.667	367.03	19.25
ExMHPWeir	141.60	13.534	114.97	13.75
GolfcartDS	129.64	14.021	223.81	14.00
GolfcartUS	129.88	14.004	224.94	13.75
HowardDS	130.03	13.981	224.04	13.75
HowardUS	130.13	13.953	224.43	13.50
LAGOON	145.45	26.368	78.45	15.00
Lake Blanton_West	129.09	14.078	223.36	14.00
Lake bonnet	145.45	26.407	475.43	12.50
LakeBlanton_East	129.11	14.081	223.77	14.00
MayManorEast	141.77	13.671	46.18	15.25
MayManorEast_2	141.77	13.682	41.16	16.00
MayManorHead	141.77	13.680	40.41	16.50
MayManorWest	141.76	13.673	50.43	14.00
NC0020	195.94	15.527	22.96	15.50
NC0040	192.66	15.507	24.23	15.50
NC0060	199.74	12.463	17.19	12.50
NC0080	198.51	14.288	31.11	14.25
NC0090	187.43	15.064	56.32	15.00
NC0100	190.79	15.881	17.23	15.50
NC0120S	188.07	27.117	3.96	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.05	0.000	0.00	0.00
NC0120Sd	185.51	13.160	0.67	13.00
NC0140	168.93	12.637	17.97	12.50
NC0160	204.29	12.201	14.44	12.25
NC0180	196.05	12.484	34.18	12.50
NC0200	158.79	12.592	31.94	12.50
NC0240	142.43	15.505	23.51	15.50
NC0260	142.29	14.532	8.35	12.75
NC0300	149.66	13.458	16.23	13.50
NC0360	151.28	14.421	12.40	14.25
NC0365	147.84	14.528	12.29	14.50
NC0370	148.17	12.428	21.10	12.50
NC0380	144.29	12.382	39.52	12.50
NC0382	142.60	12.436	39.69	12.50
NC0390	149.68	12.700	27.59	12.75

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	141.48	13.546	143.12	13.50
NC0430	134.51	18.016	6.14	12.75
NC0440	134.50	18.259	11.11	13.00
NC0442	134.37	18.510	2.85	17.75
NC0460	132.40	13.607	225.06	13.50
NC0462	131.10	13.717	225.24	13.50
NC0480	128.04	14.097	224.06	14.00
NC0482	126.99	14.113	223.99	14.00
NC0500	132.47	13.713	5.86	13.50
NC0510	132.29	12.952	26.40	12.00
NC0520	129.87	13.202	36.56	12.25
NC0540	123.97	20.025	190.24	14.50
NC0540_E1	123.98	20.087	223.79	14.00
NC0540_E2	123.98	20.055	362.83	14.50
NC0540_E3	123.98	20.055	202.62	15.00
NC0540_E4	123.98	19.962	188.31	14.50
NC0540_E5	123.97	20.003	181.93	14.75
NC0560	123.98	20.340	7.26	15.25
NC0570	124.12	30.600	19.44	22.25
NC0572	124.83	14.130	223.87	14.00
NC0590	123.89	24.727	141.47	15.25
NC0620	126.13	16.089	3.65	15.75
NC0630	126.34	12.450	87.93	12.25
NC0631	123.89	24.719	140.05	15.25
NC0632	123.88	35.507	141.03	15.50
NC0635	123.88	35.366	493.79	15.75
NC0640	123.81	35.484	475.46	16.00
NC0650	123.74	35.476	459.75	16.75
NC0660	148.01	12.305	30.57	12.25
NC0670	137.50	13.110	30.45	12.25
NC0680	131.18	0.000	10.67	12.75
NC0700	128.00	13.085	13.87	13.00
NC0720	127.25	24.846	92.91	13.25
NC0722	127.19	24.251	27.20	13.25
NC0740	132.41	13.126	15.08	12.75
NC0760	128.74	13.138	27.79	13.00
NC0780	127.16	13.147	37.63	13.00
NC0781	127.08	13.152	9.49	13.25
NC0782	126.88	13.156	9.50	13.25
NC0783	126.03	13.175	9.53	13.25
NC0784	125.04	23.816	9.55	13.25
NC0785	124.97	23.761	9.56	13.25
NC0787	124.89	23.740	28.56	12.50
NC0800	124.72	24.242	29.61	12.50

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	123.24	59.750	11.25	14.75
NC0840	123.24	58.921	16.20	0.25
NC0860	123.25	58.579	16.14	12.25
NC0880	123.25	58.374	26.58	16.75
NC0882	123.70	35.791	17.74	16.75
NC0900	130.16	12.638	24.46	12.50
NC0912	129.67	12.788	23.67	12.75
NC0920	129.97	14.642	44.36	12.25
NC0925	129.29	13.355	34.08	12.75
NC0930	132.61	19.556	6.87	13.50
NC0935	129.97	14.653	25.87	12.25
NC0937	126.22	13.558	28.39	13.25
NC0940	134.47	15.675	1.88	13.25
NC0950	131.04	12.314	14.61	12.25
NC0955	125.72	12.338	14.16	12.25
NC0960	124.41	13.872	42.94	13.25
NC0960_S1	123.70	35.783	46.00	13.50
NC0960_S2	123.70	35.756	37.41	13.50
NC0980	124.31	13.917	3.91	14.00
NC1000	123.77	12.201	16.86	12.25
NC1020	123.70	35.762	63.51	13.00
NC1030	123.70	35.790	48.64	15.25
NC1035	123.72	12.128	8.05	12.00
NC1040	123.70	35.898	55.32	15.00
NC1050	123.71	35.549	71.12	15.00
NC1060	123.58	35.394	441.41	19.00
NC1060_E	123.71	35.581	455.07	17.00
NC1070	123.52	35.362	441.28	19.00
NC1180	126.56	17.717	6.52	12.50
NC1190	123.46	35.515	0.70	17.50
NC1200	123.46	35.514	5.52	18.00
NC1210	123.46	35.377	440.86	19.00
NC1220	123.25	35.444	66.38	12.50
NC1230	123.25	35.018	66.07	12.50
NC1360	123.25	34.715	430.52	19.25
NC1362	123.04	34.692	400.80	19.50
NC1380	123.85	13.582	5.07	13.50
NC1382	123.21	14.606	5.05	13.50
NH1042	127.53	17.167	0.00	0.00
NH1044	127.30	17.206	342.72	17.00
NH1060	126.56	17.447	342.67	17.00
NH1060_SA	128.66	12.505	27.29	12.25
NH1080	124.13	22.042	354.53	16.75
NH1082	124.01	24.568	353.27	17.00

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	123.90	35.620	352.46	17.00
SterlingCanal	141.76	13.684	72.99	14.00
SterlingCanal_East	141.76	13.682	47.49	15.50
SterlingCanal_N	142.55	13.530	16.23	13.50
WabashDS	141.55	13.527	143.15	13.25
WabashUS	141.59	13.538	122.45	13.75
WoodallDS	141.05	13.561	166.97	13.50
WoodallUS	141.38	13.554	167.13	13.50

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.54	13.388	61.10	25.00
BridgeBlvdDS	142.47	13.338	166.08	13.75
BridgeBlvdUS	142.51	13.358	127.41	14.25
BrunnellDS	142.53	13.394	61.11	25.00
ChestnutDS	138.38	13.333	332.75	13.25
ChestnutUS	141.13	13.309	333.55	13.25
Downstream TW	124.10	42.167	549.61	21.00
ExMHPWeir	142.42	13.306	194.43	13.50
GolfcartDS	130.49	14.160	362.67	14.00
GolfcartUS	130.92	14.135	368.05	13.75
HowardDS	130.98	14.116	378.49	13.50
HowardUS	131.18	14.020	380.12	13.50
LAGOON	146.07	24.973	142.09	14.50
Lake Blanton_West	129.87	14.217	362.00	14.25
Lake bonnet	146.07	24.984	756.60	12.50
LakeBlanton_East	129.88	14.206	362.27	14.00
MayManorEast	142.52	13.373	86.53	17.75
MayManorEast_2	142.53	13.390	82.82	19.50
MayManorHead	142.53	13.380	82.45	19.50
MayManorWest	142.52	13.363	86.65	17.75
NC0020	196.68	15.436	39.61	15.50
NC0040	193.42	15.395	41.50	15.50
NC0060	204.02	14.083	27.51	12.50
NC0080	203.50	14.389	52.18	14.25
NC0090	188.69	14.825	103.76	14.75
NC0100	192.52	16.907	31.46	15.25
NC0120S	189.14	27.117	10.88	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.26	12.566	0.03	12.50
NC0120Sd	186.26	12.542	5.87	12.50
NC0140	169.65	12.632	28.99	12.50
NC0160	204.53	12.196	22.17	12.25
NC0180	199.08	12.508	53.40	12.50
NC0200	163.56	12.824	51.23	12.50
NC0240	142.66	15.108	38.87	15.50
NC0260	142.93	13.974	13.08	12.75
NC0300	150.15	13.421	27.93	13.50
NC0360	151.48	14.343	20.20	14.25
NC0365	148.16	14.432	20.07	14.25
NC0370	148.49	12.414	32.34	12.50
NC0380	145.22	12.461	65.25	12.50
NC0382	144.81	12.495	65.53	12.50
NC0390	153.11	12.917	44.30	12.75

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	142.13	13.330	248.05	13.00
NC0430	134.97	17.363	9.59	12.75
NC0440	134.95	18.038	17.03	13.00
NC0442	134.59	18.318	4.67	17.50
NC0460	133.62	13.421	379.71	13.25
NC0462	132.07	13.634	381.00	13.50
NC0480	128.67	14.220	364.81	14.25
NC0482	128.05	14.227	364.85	14.25
NC0500	132.99	13.983	8.98	13.25
NC0510	132.67	13.203	41.11	12.00
NC0520	130.18	12.716	54.24	12.25
NC0540	125.20	37.591	334.33	14.75
NC0540_E1	125.21	37.645	364.88	14.25
NC0540_E2	125.21	37.552	569.37	14.75
NC0540_E3	125.21	37.552	344.63	14.50
NC0540_E4	125.21	37.646	328.43	14.50
NC0540_E5	125.21	37.590	323.12	14.75
NC0560	125.20	38.256	12.93	14.25
NC0570	125.21	37.653	103.74	16.25
NC0572	125.47	14.247	364.88	14.25
NC0590	125.16	37.396	252.98	15.00
NC0620	126.32	16.479	5.36	15.75
NC0630	126.53	12.406	135.17	12.25
NC0631	125.16	37.397	251.18	15.00
NC0632	125.15	37.399	252.03	15.00
NC0635	125.15	37.330	682.00	15.25
NC0640	125.10	37.517	656.14	15.50
NC0650	124.92	38.281	642.69	18.25
NC0660	150.18	12.380	59.23	12.25
NC0670	137.77	12.452	55.89	12.50
NC0680	131.18	0.000	18.44	12.75
NC0700	129.13	24.476	25.85	13.00
NC0720	129.13	24.513	171.89	12.75
NC0722	128.89	23.166	37.05	13.00
NC0740	132.69	13.022	26.05	12.75
NC0760	130.24	13.288	51.38	13.00
NC0780	129.73	13.645	69.74	13.00
NC0781	129.38	13.611	21.15	13.75
NC0782	128.85	13.534	21.16	13.75
NC0783	127.57	13.201	21.16	13.75
NC0784	127.26	13.094	21.19	14.00
NC0785	127.13	13.043	21.20	14.00
NC0787	126.81	12.913	54.73	12.50
NC0800	125.22	37.665	55.20	13.00

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	123.83	59.750	19.14	14.75
NC0840	123.84	59.750	16.20	0.25
NC0860	123.84	59.750	29.68	12.25
NC0880	123.84	59.750	38.54	16.00
NC0882	124.87	38.694	24.53	15.25
NC0900	130.31	12.635	38.34	12.50
NC0912	129.99	12.752	37.13	12.50
NC0920	130.47	15.032	41.70	12.00
NC0925	129.54	13.374	49.23	12.75
NC0930	132.85	18.362	11.06	13.50
NC0935	130.47	15.043	45.58	12.25
NC0937	126.37	13.620	41.44	13.50
NC0940	134.75	15.194	4.43	13.00
NC0950	131.06	12.297	23.09	12.25
NC0955	125.85	12.264	22.97	12.25
NC0960	124.88	38.697	69.15	13.25
NC0960_S1	124.88	38.687	75.10	13.50
NC0960_S2	124.88	38.692	61.30	13.50
NC0980	124.88	38.690	8.10	13.75
NC1000	124.88	38.789	25.69	12.25
NC1020	124.88	38.736	85.05	12.50
NC1030	124.88	38.692	46.78	14.50
NC1035	124.88	38.810	12.27	12.00
NC1040	124.88	38.595	55.12	14.50
NC1050	124.89	38.410	76.26	14.25
NC1060	124.79	38.706	633.87	19.00
NC1060_E	124.89	38.348	640.16	18.25
NC1070	124.63	39.392	633.24	19.00
NC1180	126.81	16.119	11.39	12.50
NC1190	124.56	39.926	1.64	15.75
NC1200	124.56	39.925	25.13	16.25
NC1210	124.56	39.782	632.61	19.00
NC1220	124.35	41.241	103.01	12.50
NC1230	124.35	41.061	96.18	12.75
NC1360	124.35	40.806	612.77	19.50
NC1362	124.10	42.191	578.01	20.50
NC1380	124.21	13.618	7.73	13.50
NC1382	124.10	42.590	7.66	13.50
NH1042	128.51	34.667	0.00	0.00
NH1044	128.26	34.696	536.53	34.50
NH1060	127.37	34.837	536.59	34.75
NH1060_SA	129.28	12.653	43.47	12.25
NH1080	125.47	36.242	536.56	34.75
NH1082	125.35	36.515	535.94	34.75

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	125.18	37.220	535.67	34.75
SterlingCanal	142.52	13.385	119.49	14.50
SterlingCanal_East	142.52	13.376	87.89	17.00
SterlingCanal_N	143.15	13.436	27.94	13.50
WabashDS	142.26	13.298	248.39	13.00
WabashUS	142.40	13.298	208.12	13.25
WoodallDS	141.37	13.374	282.85	13.25
WoodallUS	142.01	13.346	283.56	13.25

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.85	13.936	86.48	24.75
BridgeBlvdDS	142.77	13.743	215.54	14.75
BridgeBlvdUS	142.81	13.783	177.15	15.00
BrunnellDS	142.84	13.868	86.49	24.75
ChestnutDS	138.83	13.275	391.77	13.25
ChestnutUS	141.19	13.242	391.70	13.25
Downstream TW	124.93	41.167	749.99	34.75
ExMHPWeir	142.71	13.623	237.36	14.25
GolfcartDS	130.84	14.320	429.26	14.25
GolfcartUS	131.36	14.286	434.82	13.75
HowardDS	131.40	14.277	443.57	13.50
HowardUS	131.71	14.162	448.88	13.50
LAGOON	146.42	24.613	176.86	14.25
Lake Blanton_West	130.20	14.366	428.62	14.25
Lake bonnet	146.41	24.622	927.03	12.50
LakeBlanton_East	130.22	14.365	429.11	14.25
MayManorEast	142.83	13.827	126.35	15.75
MayManorEast_2	142.83	13.846	111.91	20.00
MayManorHead	142.84	13.855	111.72	19.75
MayManorWest	142.82	13.818	131.03	15.75
NC0020	197.09	15.413	49.84	15.50
NC0040	193.85	15.350	52.15	15.25
NC0060	204.40	13.090	33.67	12.50
NC0080	203.62	14.221	65.13	14.25
NC0090	189.24	14.775	126.30	14.75
NC0100	193.81	18.033	40.40	15.25
NC0120S	189.78	27.117	15.78	12.50
NC0120Sa	186.72	12.578	0.04	12.50
NC0120Sb	186.73	12.505	0.05	12.50
NC0120Sc	186.73	12.499	0.34	12.25
NC0120Sd	186.73	12.492	11.01	12.50
NC0140	170.29	12.653	35.59	12.50
NC0160	204.60	12.186	26.77	12.25
NC0180	199.16	12.494	65.12	12.50
NC0200	163.82	12.612	62.75	12.50
NC0240	142.85	13.955	48.19	15.50
NC0260	143.01	13.549	16.48	12.75
NC0300	150.40	13.404	35.10	13.50
NC0360	151.59	14.316	24.91	14.00
NC0365	148.31	14.393	24.80	14.25
NC0370	148.65	12.419	39.03	12.50
NC0380	145.44	12.420	79.40	12.50
NC0382	144.97	12.476	79.84	12.50
NC0390	153.17	12.788	54.30	12.75

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	142.34	13.536	284.89	13.50
NC0430	135.19	16.366	11.65	12.75
NC0440	135.15	17.795	20.42	13.25
NC0442	134.72	18.060	6.05	17.50
NC0460	134.05	13.458	449.59	13.25
NC0462	132.33	13.765	450.95	13.25
NC0480	128.98	14.384	431.66	14.25
NC0482	128.48	14.388	431.55	14.50
NC0500	133.18	13.982	10.86	13.25
NC0510	132.78	12.822	49.86	12.00
NC0520	130.36	12.710	65.33	12.00
NC0540	126.13	35.864	424.97	14.75
NC0540_E1	126.14	35.928	431.70	14.50
NC0540_E2	126.14	35.994	712.79	14.50
NC0540_E3	126.14	35.924	418.19	14.75
NC0540_E4	126.14	36.005	410.68	14.75
NC0540_E5	126.14	36.018	406.87	14.75
NC0560	126.13	36.845	15.64	14.00
NC0570	126.14	35.929	198.21	15.25
NC0572	126.15	35.789	431.65	14.50
NC0590	126.08	35.864	289.30	16.75
NC0620	126.42	16.718	6.39	15.75
NC0630	126.62	12.394	163.27	12.25
NC0631	126.08	35.777	287.00	16.75
NC0632	126.07	35.781	288.20	16.75
NC0635	126.07	35.759	844.32	17.00
NC0640	126.03	35.900	829.57	32.75
NC0650	125.92	36.428	826.06	33.00
NC0660	150.36	12.282	77.38	12.25
NC0670	137.79	12.228	77.10	12.25
NC0680	131.18	0.000	23.18	12.75
NC0700	130.11	24.416	33.38	13.00
NC0720	130.11	24.456	248.65	13.00
NC0722	130.10	24.403	38.81	12.75
NC0740	132.82	12.986	32.74	12.75
NC0760	130.34	13.037	65.96	13.00
NC0780	130.12	13.109	92.16	12.75
NC0781	129.89	13.078	21.86	25.75
NC0782	129.52	13.051	21.86	25.75
NC0783	128.55	12.995	21.87	26.00
NC0784	128.30	12.989	21.87	26.00
NC0785	128.19	12.978	21.87	26.00
NC0787	127.91	12.969	68.12	12.25
NC0800	126.14	35.931	65.44	13.00

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	124.19	59.750	23.64	14.75
NC0840	124.20	59.750	19.01	13.75
NC0860	124.20	59.750	38.10	12.25
NC0880	124.21	59.750	46.42	15.75
NC0882	125.88	36.693	28.32	14.75
NC0900	130.38	12.624	46.60	12.50
NC0912	130.15	12.736	45.26	12.50
NC0920	130.72	15.105	49.87	12.50
NC0925	129.67	13.351	58.76	12.75
NC0930	132.97	17.941	13.57	13.50
NC0935	130.72	15.115	56.07	12.25
NC0937	126.46	13.569	50.43	13.50
NC0940	134.90	15.102	6.20	13.00
NC0950	131.07	12.294	28.23	12.25
NC0955	125.90	12.252	28.11	12.25
NC0960	125.88	36.724	86.30	13.50
NC0960_S1	125.88	36.796	94.01	13.50
NC0960_S2	125.88	36.714	78.56	13.75
NC0980	125.88	36.796	10.86	13.75
NC1000	125.88	36.858	30.94	12.25
NC1020	125.88	36.693	97.59	13.00
NC1030	125.88	36.693	46.20	14.50
NC1035	125.88	36.820	14.78	12.00
NC1040	125.88	36.656	57.34	14.25
NC1050	125.89	36.525	80.69	13.50
NC1060	125.83	36.753	790.73	18.75
NC1060_E	125.89	36.564	824.46	33.00
NC1070	125.51	37.939	787.88	18.75
NC1180	126.95	15.862	14.36	12.50
NC1190	125.43	38.429	2.33	15.75
NC1200	125.43	38.429	40.99	15.50
NC1210	125.43	38.293	786.95	18.75
NC1220	125.22	39.842	124.80	12.50
NC1230	125.22	39.631	108.12	12.75
NC1360	125.22	39.441	770.26	34.50
NC1362	124.94	41.519	758.09	35.00
NC1380	124.93	41.997	9.32	13.50
NC1382	124.93	41.742	9.81	21.00
NH1042	129.23	32.417	0.00	0.00
NH1044	128.93	32.451	752.93	32.25
NH1060	128.04	32.729	752.76	32.25
NH1060_SA	129.52	12.745	53.12	12.25
NH1080	126.55	34.257	752.69	32.50
NH1082	126.41	34.617	751.81	32.50

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	126.10	35.631	751.50	32.50
SterlingCanal	142.82	13.816	171.31	15.00
SterlingCanal_East	142.82	13.816	132.84	15.50
SterlingCanal_N	143.44	13.493	35.11	13.50
WabashDS	142.50	13.521	284.88	13.50
WabashUS	142.69	13.624	247.75	14.00
WoodallDS	141.50	13.443	331.68	13.50
WoodallUS	142.21	13.525	331.75	13.50

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	143.70	15.737	154.58	24.25
BridgeBlvdDS	143.45	14.509	316.21	16.25
BridgeBlvdUS	143.47	14.567	278.34	16.75
BrunnellDS	143.55	14.834	154.57	24.25
ChestnutDS	139.74	13.370	529.89	13.25
ChestnutUS	141.32	13.314	530.42	13.25
Downstream TW	126.05	38.167	1252.82	31.75
ExMHPWeir	143.36	14.266	340.87	15.00
GolfcartDS	131.52	14.792	569.10	14.75
GolfcartUS	132.40	14.743	577.73	14.25
HowardDS	132.42	14.751	587.15	13.75
HowardUS	132.94	14.566	603.31	13.50
LAGOON	147.18	24.143	287.47	12.75
Lake Blanton_West	130.83	14.856	569.12	14.75
Lake bonnet	147.17	24.150	1350.88	12.50
LakeBlanton_East	130.85	14.843	569.00	14.75
MayManorEast	143.51	14.671	219.64	17.75
MayManorEast_2	143.51	14.680	202.40	17.75
MayManorHead	143.54	14.770	197.45	18.75
MayManorWest	143.50	14.672	223.42	17.75
NC0020	201.49	16.138	75.77	15.25
NC0040	196.16	18.156	76.04	16.00
NC0060	204.66	12.601	48.95	12.50
NC0080	203.80	14.187	96.21	14.25
NC0090	190.38	14.543	172.47	14.50
NC0100	196.17	18.178	71.25	15.25
NC0120S	191.36	27.117	29.88	12.25
NC0120Sa	188.12	12.471	0.58	12.25
NC0120Sb	188.12	12.460	1.38	12.25
NC0120Sc	188.12	12.454	1.97	12.25
NC0120Sd	188.12	12.449	28.09	12.50
NC0140	174.63	12.638	51.96	12.50
NC0160	204.73	12.173	38.17	12.25
NC0180	199.28	12.486	94.23	12.50
NC0200	163.91	12.571	91.34	12.50
NC0240	143.55	14.782	71.56	15.50
NC0260	143.54	14.772	23.74	12.50
NC0300	150.99	13.385	53.09	13.50
NC0360	152.13	14.662	36.72	14.00
NC0365	148.60	14.729	35.26	14.75
NC0370	148.94	12.426	55.62	12.50
NC0380	145.85	12.430	115.07	12.50
NC0382	145.21	12.459	116.06	12.50
NC0390	153.26	12.759	79.11	12.75

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	142.73	13.817	384.73	14.25
NC0430	135.78	14.408	16.75	12.75
NC0440	135.37	16.472	27.24	13.25
NC0442	135.23	16.666	13.24	16.25
NC0460	134.90	13.701	613.95	13.25
NC0462	133.07	14.564	615.72	13.50
NC0480	129.67	14.855	574.00	14.75
NC0482	129.26	14.863	573.92	14.75
NC0500	133.49	13.987	15.51	13.25
NC0510	132.89	12.413	71.53	12.00
NC0520	130.59	12.389	114.94	12.25
NC0540	127.38	30.841	559.21	14.00
NC0540_E1	127.40	30.879	572.92	14.75
NC0540_E2	127.39	30.879	774.13	16.25
NC0540_E3	127.39	30.845	567.02	16.50
NC0540_E4	127.39	30.967	536.07	15.50
NC0540_E5	127.39	30.974	525.64	15.75
NC0560	127.39	31.285	27.50	12.75
NC0570	127.39	30.855	325.41	14.00
NC0572	127.40	30.839	573.85	14.75
NC0590	127.33	31.149	521.67	17.25
NC0620	127.34	31.053	8.96	15.75
NC0630	127.31	31.492	232.95	12.25
NC0631	127.32	31.214	519.64	17.25
NC0632	127.32	31.295	522.43	17.25
NC0635	127.31	31.302	1334.24	29.00
NC0640	127.27	31.422	1326.95	29.50
NC0650	127.22	31.550	1325.24	29.25
NC0660	150.56	12.267	123.90	12.25
NC0670	137.88	12.339	123.75	12.25
NC0680	131.18	0.000	35.06	12.75
NC0700	131.10	17.453	76.61	14.75
NC0720	131.09	17.456	419.37	12.75
NC0722	131.09	17.467	36.59	12.50
NC0740	133.08	12.893	49.51	12.75
NC0760	131.09	17.446	103.05	13.00
NC0780	131.08	17.454	148.95	12.75
NC0781	131.04	17.857	18.38	33.25
NC0782	130.98	18.071	18.38	33.25
NC0783	130.82	18.304	18.38	33.25
NC0784	130.77	18.378	18.39	33.50
NC0785	130.76	18.349	18.39	33.25
NC0787	130.71	18.401	112.62	17.25
NC0800	127.39	30.859	112.47	18.25

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	124.85	59.750	33.99	14.75
NC0840	124.87	59.750	28.04	13.50
NC0860	124.87	59.750	59.42	12.25
NC0880	124.87	59.750	70.99	16.75
NC0882	127.18	31.733	35.99	13.50
NC0900	130.56	12.710	67.10	12.50
NC0912	130.46	12.746	64.20	12.50
NC0920	131.23	15.249	72.58	12.50
NC0925	129.91	13.297	82.07	12.75
NC0930	133.23	17.450	19.82	13.50
NC0935	131.24	15.258	80.11	12.25
NC0937	127.19	31.738	74.28	13.25
NC0940	135.23	15.067	11.01	13.00
NC0950	131.09	12.291	41.27	12.25
NC0955	127.19	31.738	41.13	12.25
NC0960	127.19	31.726	134.91	13.25
NC0960_S1	127.19	31.821	143.71	13.75
NC0960_S2	127.18	31.720	128.72	13.75
NC0980	127.19	31.822	18.14	13.75
NC1000	127.18	31.981	43.98	12.25
NC1020	127.18	31.791	137.76	12.50
NC1030	127.18	31.732	75.49	16.50
NC1035	127.18	31.868	21.00	12.00
NC1040	127.18	31.732	95.28	16.50
NC1050	127.19	31.729	109.37	16.50
NC1060	127.14	31.879	1305.66	29.50
NC1060_E	127.19	31.733	1324.68	29.25
NC1070	126.84	33.042	1304.43	29.75
NC1180	127.29	15.469	21.82	12.50
NC1190	126.75	33.403	4.19	15.50
NC1200	126.75	33.403	68.47	14.50
NC1210	126.75	33.349	1303.47	29.75
NC1220	126.45	35.405	178.85	12.50
NC1230	126.49	34.800	123.77	13.00
NC1360	126.49	34.742	1289.42	30.00
NC1362	126.05	38.229	1263.28	30.25
NC1380	126.43	35.550	22.16	13.00
NC1382	126.05	38.211	20.63	22.25
NH1042	130.29	29.917	0.00	0.00
NH1044	129.93	30.157	1122.50	29.75
NH1060	129.07	30.221	1122.28	30.00
NH1060_SA	130.00	12.953	77.03	12.25
NH1080	127.95	30.544	1123.37	30.00
NH1082	127.82	30.617	1123.11	30.25

Lake Bonnet Drain

Alternative 1 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	127.35	31.179	1123.06	30.25
SterlingCanal	143.49	14.620	269.95	17.50
SterlingCanal_East	143.50	14.633	231.46	17.75
SterlingCanal_N	144.04	13.554	53.11	13.50
WabashDS	142.97	13.848	384.68	14.25
WabashUS	143.33	14.243	347.85	15.00
WoodallDS	141.77	13.637	448.55	13.75
WoodallUS	142.59	13.756	448.49	13.75

APPENDIX B3

Alternative 2 Model Results

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.66	14.116	25.11	26.25
BridgeBlvdDS	141.53	13.888	94.20	14.50
BridgeBlvdUS	141.64	14.092	71.86	14.75
BrunnellDS	141.66	14.105	25.11	26.25
ChestnutDS	136.92	13.771	178.29	13.75
ChestnutUS	140.93	13.757	178.27	13.75
Downstream TW	123.04	33.667	363.79	19.50
ExMHPWeir	141.49	13.870	107.41	14.25
GolfcartDS	129.53	14.144	208.82	14.00
GolfcartUS	129.75	14.120	209.52	14.00
HowardDS	129.90	14.100	207.79	13.75
HowardUS	130.00	14.079	208.12	13.75
LAGOON	145.45	26.368	78.45	15.00
Lake Blanton_West	128.99	14.215	208.00	14.25
Lake bonnet	145.45	26.408	475.44	12.50
LakeBlanton_East	129.00	14.212	208.52	14.00
MayManorEast	141.65	14.081	59.10	16.25
MayManorEast_2	141.65	14.117	40.89	16.50
MayManorHead	141.65	14.117	40.09	16.50
MayManorWest	141.64	14.087	46.07	15.75
NC0020	195.94	15.519	22.96	15.50
NC0040	192.66	15.508	24.23	15.50
NC0060	199.74	12.462	17.19	12.50
NC0080	198.51	14.288	31.11	14.25
NC0090	187.43	15.058	56.32	15.00
NC0100	190.79	15.881	17.23	15.50
NC0120S	188.07	27.117	3.96	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.05	0.000	0.00	0.00
NC0120Sd	185.51	13.148	0.67	13.00
NC0140	168.93	12.637	17.97	12.50
NC0160	204.29	12.201	14.44	12.25
NC0180	196.05	12.484	34.18	12.50
NC0200	158.79	12.592	31.94	12.50
NC0240	142.43	15.553	23.51	15.50
NC0260	142.20	14.620	8.35	12.75
NC0300	149.66	13.458	16.23	13.50
NC0360	151.28	14.421	12.40	14.25
NC0365	147.84	14.526	12.29	14.50
NC0370	148.17	12.428	21.10	12.50
NC0380	144.29	12.382	39.52	12.50
NC0382	142.61	12.394	39.69	12.50
NC0390	151.37	12.681	27.59	12.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	141.39	13.850	129.97	13.75
NC0430	134.51	18.037	6.14	12.75
NC0440	134.50	18.267	11.11	13.00
NC0442	134.37	18.492	2.85	17.75
NC0460	132.24	13.774	207.50	13.75
NC0462	130.95	13.880	208.33	13.75
NC0480	127.97	14.228	209.12	14.25
NC0482	126.86	14.246	209.14	14.25
NC0500	132.47	13.713	5.86	13.50
NC0510	132.29	12.952	26.40	12.00
NC0520	129.87	13.202	36.56	12.25
NC0540	123.96	24.277	178.25	14.75
NC0540_E1	123.98	20.359	209.14	14.25
NC0540_E2	123.98	20.383	327.02	16.00
NC0540_E3	123.97	20.451	195.60	15.00
NC0540_E4	123.97	20.625	175.72	14.75
NC0540_E5	123.97	20.480	169.65	14.75
NC0560	123.97	20.836	6.97	15.50
NC0570	124.12	30.703	19.65	22.50
NC0572	124.76	14.268	209.15	14.25
NC0590	123.90	24.746	132.46	15.75
NC0620	126.13	16.089	3.65	15.75
NC0630	126.34	12.450	87.93	12.25
NC0631	123.89	24.828	131.36	15.75
NC0632	123.88	35.573	132.67	15.75
NC0635	123.88	35.495	487.32	16.00
NC0640	123.81	35.382	470.79	16.50
NC0650	123.74	35.438	458.12	17.00
NC0660	148.01	12.305	30.57	12.25
NC0670	137.50	13.111	30.45	12.25
NC0680	131.18	0.000	10.67	12.75
NC0700	128.00	13.085	13.87	13.00
NC0720	127.25	24.846	92.91	13.25
NC0722	127.19	24.259	27.20	13.25
NC0740	132.41	13.126	15.08	12.75
NC0760	128.74	13.138	27.78	13.00
NC0780	127.16	13.147	37.64	13.00
NC0781	127.08	13.154	9.49	13.25
NC0782	126.88	13.158	9.50	13.25
NC0783	126.03	13.176	9.53	13.25
NC0784	125.04	23.792	9.55	13.25
NC0785	124.97	23.810	9.56	13.25
NC0787	124.89	23.740	28.56	12.50
NC0800	124.72	24.241	29.61	12.50

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	123.24	60.286	11.25	14.75
NC0840	123.24	58.906	16.20	0.25
NC0860	123.24	58.558	16.14	12.25
NC0880	123.25	58.344	26.34	16.75
NC0882	123.70	35.634	17.40	16.75
NC0900	130.16	12.638	24.46	12.50
NC0912	129.67	12.788	23.67	12.75
NC0920	129.97	14.643	44.36	12.25
NC0925	129.29	13.354	34.09	12.75
NC0930	132.61	19.555	6.87	13.50
NC0935	129.97	14.653	25.87	12.25
NC0937	126.22	13.560	28.39	13.25
NC0940	134.47	15.675	1.88	13.25
NC0950	131.04	12.314	14.61	12.25
NC0955	125.72	12.338	14.16	12.25
NC0960	124.41	13.851	42.94	13.25
NC0960_S1	123.70	35.579	46.00	13.50
NC0960_S2	123.70	35.578	37.45	13.50
NC0980	124.31	13.917	3.91	14.00
NC1000	123.77	12.201	16.86	12.25
NC1020	123.70	35.598	63.51	13.00
NC1030	123.70	35.632	44.95	15.25
NC1035	123.72	12.129	8.05	12.00
NC1040	123.70	35.748	51.51	15.00
NC1050	123.71	35.486	66.86	15.00
NC1060	123.59	35.586	437.73	19.00
NC1060_E	123.71	35.226	453.82	17.00
NC1070	123.52	35.298	437.58	19.00
NC1180	126.56	17.717	6.52	12.50
NC1190	123.46	35.512	0.70	17.50
NC1200	123.46	35.511	8.55	16.75
NC1210	123.46	35.242	437.14	19.25
NC1220	123.25	35.410	66.38	12.50
NC1230	123.25	34.996	66.07	12.50
NC1360	123.25	34.726	428.61	19.50
NC1362	123.04	34.623	397.89	19.75
NC1380	123.85	13.583	5.07	13.50
NC1382	123.21	14.606	5.05	13.50
NH1042	127.53	17.167	0.00	0.00
NH1044	127.30	17.204	342.88	17.00
NH1060	126.56	17.465	342.84	17.00
NH1060_SA	128.66	12.505	27.29	12.25
NH1080	124.13	22.272	354.70	16.75
NH1082	124.01	24.576	353.38	17.00

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	123.91	24.909	352.53	17.00
SterlingCanal	141.64	14.099	67.93	14.75
SterlingCanal_East	141.64	14.099	52.72	16.25
SterlingCanal_N	142.52	13.559	16.23	13.50
WabashDS	141.45	13.838	129.96	13.75
WabashUS	141.48	13.843	112.85	14.00
WoodallDS	141.01	13.814	153.14	13.75
WoodallUS	141.29	13.821	153.31	13.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.42	13.784	61.08	25.00
BridgeBlvdDS	142.34	13.732	163.80	14.50
BridgeBlvdUS	142.39	13.790	124.87	14.50
BrunnellDS	142.41	13.821	61.09	25.00
ChestnutDS	138.19	13.539	308.03	13.50
ChestnutUS	141.10	13.519	308.17	13.50
Downstream TW	124.10	42.167	554.65	21.25
ExMHPWeir	142.29	13.680	185.28	14.25
GolfcartDS	130.40	14.306	345.20	14.25
GolfcartUS	130.79	14.280	349.37	14.00
HowardDS	130.86	14.262	354.37	13.50
HowardUS	131.04	14.196	355.78	13.50
LAGOON	146.07	24.974	142.09	14.50
Lake Blanton_West	129.78	14.351	344.60	14.25
Lake bonnet	146.07	24.985	756.59	12.50
LakeBlanton_East	129.79	14.358	345.07	14.25
MayManorEast	142.40	13.746	86.79	17.25
MayManorEast_2	142.40	13.831	82.82	19.50
MayManorHead	142.41	13.845	82.39	19.50
MayManorWest	142.40	13.821	86.93	17.25
NC0020	196.68	15.449	39.61	15.50
NC0040	193.42	15.383	41.49	15.25
NC0060	204.02	14.083	27.51	12.50
NC0080	203.50	14.388	52.18	14.25
NC0090	188.69	14.818	103.77	14.75
NC0100	192.52	16.907	31.46	15.25
NC0120S	189.14	27.117	10.88	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.26	12.564	0.03	12.50
NC0120Sd	186.26	12.542	5.87	12.50
NC0140	169.65	12.632	28.99	12.50
NC0160	204.53	12.196	22.17	12.25
NC0180	199.08	12.508	53.40	12.50
NC0200	163.56	12.824	51.23	12.50
NC0240	142.67	15.136	38.87	15.50
NC0260	142.90	14.259	13.08	12.75
NC0300	150.15	13.420	27.93	13.50
NC0360	151.48	14.343	20.20	14.25
NC0365	148.16	14.429	20.07	14.25
NC0370	148.49	12.414	32.34	12.50
NC0380	145.20	12.454	65.25	12.50
NC0382	144.76	12.484	65.56	12.50
NC0390	153.10	12.896	44.30	12.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	142.03	13.667	225.96	13.50
NC0430	134.97	17.364	9.59	12.75
NC0440	134.95	18.039	17.03	13.00
NC0442	134.59	18.304	4.67	17.50
NC0460	133.46	13.581	355.79	13.50
NC0462	131.98	13.865	357.35	13.50
NC0480	128.60	14.368	346.65	14.25
NC0482	127.93	14.371	346.58	14.25
NC0500	132.99	13.983	8.98	13.25
NC0510	132.67	13.203	41.11	12.00
NC0520	130.18	12.716	54.24	12.25
NC0540	125.21	37.541	319.40	15.00
NC0540_E1	125.22	37.589	346.48	14.50
NC0540_E2	125.22	37.515	564.29	14.00
NC0540_E3	125.22	37.515	326.40	15.00
NC0540_E4	125.21	37.537	313.16	14.75
NC0540_E5	125.21	37.503	308.08	15.00
NC0560	125.21	38.216	12.55	14.75
NC0570	125.21	37.581	101.06	16.50
NC0572	125.41	15.362	346.46	14.25
NC0590	125.17	37.298	242.54	15.00
NC0620	126.32	16.479	5.36	15.75
NC0630	126.53	12.406	135.17	12.25
NC0631	125.16	37.333	240.59	15.00
NC0632	125.16	37.332	241.76	15.25
NC0635	125.16	37.326	675.33	15.50
NC0640	125.11	37.412	651.06	15.75
NC0650	124.92	38.144	637.77	18.50
NC0660	150.18	12.380	59.23	12.25
NC0670	137.77	12.452	55.89	12.50
NC0680	131.18	0.000	18.44	12.75
NC0700	129.13	24.419	25.85	13.00
NC0720	129.13	24.510	171.89	12.75
NC0722	128.89	23.112	37.05	13.00
NC0740	132.69	13.022	26.05	12.75
NC0760	130.24	13.288	51.38	13.00
NC0780	129.73	13.645	69.74	13.00
NC0781	129.38	13.607	21.15	13.75
NC0782	128.85	13.534	21.16	13.75
NC0783	127.57	13.201	21.16	13.75
NC0784	127.26	13.092	21.19	14.00
NC0785	127.13	13.043	21.20	14.00
NC0787	126.81	12.913	54.73	12.50
NC0800	125.22	37.618	55.21	13.00

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	123.85	64.219	19.14	14.75
NC0840	123.85	63.110	16.20	0.25
NC0860	123.85	62.890	29.68	12.25
NC0880	123.85	62.784	38.34	16.00
NC0882	124.88	38.639	24.06	15.75
NC0900	130.31	12.635	38.34	12.50
NC0912	129.99	12.752	37.13	12.50
NC0920	130.47	15.032	41.70	12.00
NC0925	129.54	13.374	49.23	12.75
NC0930	132.85	18.362	11.06	13.50
NC0935	130.47	15.042	45.58	12.25
NC0937	126.37	13.622	41.44	13.50
NC0940	134.75	15.193	4.43	13.00
NC0950	131.06	12.297	23.09	12.25
NC0955	125.85	12.264	22.97	12.25
NC0960	124.88	38.540	69.15	13.25
NC0960_S1	124.88	38.587	75.16	13.50
NC0960_S2	124.88	38.589	61.83	13.50
NC0980	124.88	38.657	8.10	13.75
NC1000	124.88	38.717	25.69	12.25
NC1020	124.88	38.608	85.05	12.50
NC1030	124.88	38.568	42.01	14.50
NC1035	124.88	38.694	12.27	12.00
NC1040	124.88	38.578	50.00	14.50
NC1050	124.89	38.173	69.36	14.25
NC1060	124.80	38.540	628.89	19.25
NC1060_E	124.89	38.188	635.31	18.50
NC1070	124.63	39.266	628.05	19.00
NC1180	126.81	16.119	11.39	12.50
NC1190	124.57	39.545	1.64	15.75
NC1200	124.57	39.544	19.20	15.00
NC1210	124.56	39.618	627.59	19.25
NC1220	124.35	41.214	103.01	12.50
NC1230	124.35	40.931	96.18	12.75
NC1360	124.35	40.733	617.32	19.50
NC1362	124.10	42.193	582.87	20.50
NC1380	124.21	13.618	7.73	13.50
NC1382	124.10	42.538	7.66	13.50
NH1042	128.51	34.667	0.00	0.00
NH1044	128.26	34.700	536.49	34.75
NH1060	127.37	34.850	536.54	34.75
NH1060_SA	129.28	12.653	43.47	12.25
NH1080	125.48	36.225	536.53	34.75
NH1082	125.36	36.482	535.90	34.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	125.18	37.145	535.65	34.75
SterlingCanal	142.39	13.788	117.39	14.75
SterlingCanal_East	142.39	13.793	87.72	17.50
SterlingCanal_N	143.11	13.506	27.94	13.50
WabashDS	142.15	13.642	226.02	13.50
WabashUS	142.27	13.681	193.23	14.25
WoodallDS	141.31	13.617	263.78	13.75
WoodallUS	141.92	13.634	263.71	13.50

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.78	14.268	86.46	24.75
BridgeBlvdDS	142.70	13.994	211.91	15.00
BridgeBlvdUS	142.73	14.058	171.99	15.25
BrunnellDS	142.76	14.171	86.47	24.75
ChestnutDS	138.70	13.383	373.80	13.25
ChestnutUS	141.17	13.356	374.69	13.25
Downstream TW	124.93	41.167	756.93	34.75
ExMHPWeir	142.63	13.850	233.22	14.75
GolfcartDS	130.77	14.397	415.24	14.25
GolfcartUS	131.27	14.377	420.61	14.00
HowardDS	131.31	14.353	429.71	13.50
HowardUS	131.61	14.237	433.64	13.50
LAGOON	146.42	24.613	176.85	14.25
Lake Blanton_West	130.13	14.471	414.73	14.50
Lake bonnet	146.41	24.622	927.05	12.50
LakeBlanton_East	130.15	14.448	414.96	14.25
MayManorEast	142.75	14.125	123.54	15.75
MayManorEast_2	142.75	14.119	111.96	20.00
MayManorHead	142.76	14.164	111.74	20.00
MayManorWest	142.74	14.095	127.30	15.75
NC0020	197.09	15.407	49.84	15.50
NC0040	193.85	15.334	52.16	15.25
NC0060	204.40	13.090	33.67	12.50
NC0080	203.62	14.221	65.13	14.25
NC0090	189.24	14.788	126.30	14.75
NC0100	193.81	18.033	40.40	15.25
NC0120S	189.78	27.117	15.78	12.50
NC0120Sa	186.72	12.578	0.04	12.50
NC0120Sb	186.73	12.505	0.05	12.50
NC0120Sc	186.73	12.497	0.34	12.25
NC0120Sd	186.73	12.494	11.01	12.50
NC0140	170.29	12.653	35.59	12.50
NC0160	204.60	12.186	26.77	12.25
NC0180	199.16	12.495	65.12	12.50
NC0200	163.82	12.612	62.75	12.50
NC0240	142.80	14.344	48.19	15.50
NC0260	143.00	13.720	15.90	12.75
NC0300	150.40	13.404	35.10	13.50
NC0360	151.59	14.316	24.91	14.00
NC0365	148.31	14.396	24.80	14.25
NC0370	148.65	12.419	39.03	12.50
NC0380	145.43	12.422	79.40	12.50
NC0382	144.95	12.468	79.85	12.50
NC0390	153.17	12.795	54.29	12.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0398	142.28	13.697	272.03	13.75
NC0430	135.19	16.358	11.65	12.75
NC0440	135.15	17.795	20.42	13.25
NC0442	134.72	18.065	6.05	17.50
NC0460	133.95	13.460	432.24	13.50
NC0462	132.28	13.891	435.03	13.50
NC0480	128.92	14.453	418.14	14.50
NC0482	128.40	14.449	418.17	14.50
NC0500	133.18	13.981	10.86	13.25
NC0510	132.78	12.822	49.86	12.00
NC0520	130.36	12.709	65.33	12.00
NC0540	126.14	35.860	410.48	15.00
NC0540_E1	126.15	35.952	418.22	14.50
NC0540_E2	126.15	35.808	607.33	14.50
NC0540_E3	126.15	35.810	412.55	14.75
NC0540_E4	126.15	35.949	396.57	14.75
NC0540_E5	126.14	35.950	393.22	15.00
NC0560	126.14	36.765	15.34	14.25
NC0570	126.14	35.861	186.41	15.25
NC0572	126.16	35.803	418.21	14.50
NC0590	126.09	35.764	280.14	17.00
NC0620	126.42	16.712	6.39	15.75
NC0630	126.62	12.394	163.27	12.25
NC0631	126.08	35.767	277.97	17.00
NC0632	126.08	35.636	279.32	17.00
NC0635	126.08	35.733	837.99	33.00
NC0640	126.04	35.807	831.07	32.75
NC0650	125.92	36.406	827.59	33.00
NC0660	150.36	12.282	77.38	12.25
NC0670	137.79	12.228	77.10	12.25
NC0680	131.18	0.000	23.18	12.75
NC0700	130.11	24.343	33.38	13.00
NC0720	130.11	24.459	248.65	13.00
NC0722	130.10	24.420	38.81	12.75
NC0740	132.82	12.986	32.74	12.75
NC0760	130.34	13.036	65.96	13.00
NC0780	130.12	13.109	92.16	12.75
NC0781	129.89	13.074	21.83	26.00
NC0782	129.52	13.049	21.83	26.00
NC0783	128.55	12.997	21.83	25.75
NC0784	128.30	12.988	21.84	26.00
NC0785	128.19	12.980	21.84	26.00
NC0787	127.91	12.969	68.12	12.25
NC0800	126.15	35.869	65.44	13.00

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0820	124.24	66.825	23.64	14.75
NC0840	124.24	65.769	19.01	13.75
NC0860	124.24	65.624	38.10	12.25
NC0880	124.24	65.552	46.32	15.75
NC0882	125.88	36.554	27.91	15.00
NC0900	130.38	12.624	46.60	12.50
NC0912	130.15	12.736	45.27	12.50
NC0920	130.72	15.105	49.87	12.50
NC0925	129.67	13.351	58.76	12.75
NC0930	132.97	17.941	13.57	13.50
NC0935	130.72	15.115	56.07	12.25
NC0937	126.46	13.571	50.43	13.50
NC0940	134.90	15.102	6.20	13.00
NC0950	131.07	12.294	28.23	12.25
NC0955	125.90	12.252	28.11	12.25
NC0960	125.89	36.675	86.29	13.50
NC0960_S1	125.89	36.670	94.13	13.50
NC0960_S2	125.89	36.673	79.12	13.75
NC0980	125.89	36.670	10.86	13.75
NC1000	125.89	36.727	30.94	12.25
NC1020	125.89	36.571	94.60	13.00
NC1030	125.89	36.554	44.74	14.75
NC1035	125.89	36.658	14.78	12.00
NC1040	125.89	36.600	53.02	14.50
NC1050	125.89	36.511	74.01	13.75
NC1060	125.84	36.553	785.88	19.00
NC1060_E	125.90	36.448	826.07	33.00
NC1070	125.51	37.678	783.43	19.25
NC1180	126.95	15.862	14.36	12.50
NC1190	125.44	38.173	2.33	15.75
NC1200	125.44	38.172	26.62	14.50
NC1210	125.44	38.219	782.78	34.00
NC1220	125.22	39.749	124.80	12.50
NC1230	125.22	39.515	108.12	12.75
NC1360	125.22	39.351	777.33	34.25
NC1362	124.94	41.395	764.86	34.75
NC1380	124.93	41.986	9.32	13.50
NC1382	124.93	41.742	9.81	21.00
NH1042	129.23	32.417	0.00	0.00
NH1044	128.93	32.442	752.73	32.25
NH1060	128.04	32.727	752.56	32.25
NH1060_SA	129.52	12.745	53.12	12.25
NH1080	126.55	34.236	752.49	32.50
NH1082	126.42	34.501	751.62	32.50

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1084	126.11	35.493	751.31	32.50
SterlingCanal	142.74	14.076	168.33	15.50
SterlingCanal_East	142.74	14.055	128.59	15.50
SterlingCanal_N	143.40	13.506	35.11	13.50
WabashDS	142.43	13.705	271.99	13.75
WabashUS	142.61	13.832	239.55	14.75
WoodallDS	141.46	13.568	318.04	13.75
WoodallUS	142.16	13.664	317.86	13.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	143.65	15.858	154.55	24.25
BridgeBlvdDS	143.40	14.764	313.88	16.25
BridgeBlvdUS	143.42	14.795	274.47	16.75
BrunnellDS	143.49	15.021	154.56	24.25
ChestnutDS	139.65	13.459	514.14	13.50
ChestnutUS	141.31	13.410	514.20	13.25
Downstream TW	126.05	38.167	1259.88	30.50
ExMHPWeir	143.30	14.486	334.79	15.25
GolfcartDS	131.46	14.850	557.11	14.75
GolfcartUS	132.31	14.815	565.59	14.25
HowardDS	132.33	14.814	575.42	13.75
HowardUS	132.85	14.628	589.95	13.50
LAGOON	147.18	24.143	287.47	12.75
Lake Blanton_West	130.78	14.895	557.06	15.00
Lake bonnet	147.17	24.151	1350.93	12.50
LakeBlanton_East	130.80	14.897	556.95	14.75
MayManorEast	143.44	14.857	218.08	17.50
MayManorEast_2	143.45	14.864	201.61	17.50
MayManorHead	143.47	14.945	196.92	18.50
MayManorWest	143.44	14.857	221.54	17.50
NC0020	201.49	16.138	75.77	15.25
NC0040	196.16	18.156	76.04	16.00
NC0060	204.66	12.601	48.95	12.50
NC0080	203.80	14.187	96.21	14.25
NC0090	190.38	14.538	172.47	14.50
NC0100	196.17	18.178	71.25	15.25
NC0120S	191.36	27.117	29.88	12.25
NC0120Sa	188.12	12.471	0.58	12.25
NC0120Sb	188.12	12.459	1.38	12.25
NC0120Sc	188.12	12.453	1.97	12.25
NC0120Sd	188.12	12.449	28.09	12.50
NC0140	174.63	12.638	51.96	12.50
NC0160	204.73	12.173	38.17	12.25
NC0180	199.28	12.487	94.23	12.50
NC0200	163.91	12.571	91.34	12.50
NC0240	143.48	14.957	71.56	15.50
NC0260	143.48	14.947	22.89	12.75
NC0300	150.99	13.385	53.09	13.50
NC0360	152.13	14.662	36.72	14.00
NC0365	148.60	14.728	35.26	14.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0370	148.94	12.426	55.62	12.50
NC0380	145.85	12.433	115.07	12.50
NC0382	145.20	12.460	116.05	12.50
NC0390	153.26	12.759	79.11	12.75
NC0398	142.70	13.961	375.76	14.50
NC0430	135.78	14.407	16.75	12.75
NC0440	135.37	16.474	27.24	13.25
NC0442	135.23	16.673	13.25	16.25
NC0460	134.84	13.733	599.46	13.50
NC0462	132.99	14.543	600.96	13.50
NC0480	129.61	14.919	561.79	14.75
NC0482	129.20	14.921	561.83	15.00
NC0500	133.49	13.987	15.51	13.25
NC0510	132.89	12.413	71.53	12.00
NC0520	130.59	12.389	114.95	12.25
NC0540	127.39	30.848	546.31	14.00
NC0540_E1	127.40	30.834	560.98	15.00
NC0540_E2	127.40	30.768	919.23	16.25
NC0540_E3	127.40	30.808	539.94	15.50
NC0540_E4	127.39	30.811	525.51	15.75
NC0540_E5	127.39	30.842	515.11	16.00
NC0560	127.39	31.212	27.26	12.75
NC0570	127.39	30.789	321.94	14.00
NC0572	127.41	30.671	561.85	15.00
NC0590	127.33	31.161	512.48	18.00
NC0620	127.34	30.986	8.96	15.75
NC0630	127.32	31.453	232.95	12.25
NC0631	127.32	31.252	510.10	18.00
NC0632	127.32	31.225	512.08	18.00
NC0635	127.32	31.229	1336.58	28.25
NC0640	127.27	31.373	1329.49	29.00
NC0650	127.23	31.460	1327.97	29.25
NC0660	150.56	12.267	123.90	12.25
NC0670	137.88	12.339	123.75	12.25
NC0680	131.18	0.000	35.06	12.75
NC0700	131.10	17.453	52.59	13.00
NC0720	131.09	17.457	419.37	12.75
NC0722	131.09	17.431	36.59	12.50
NC0740	133.08	12.893	49.51	12.75
NC0760	131.09	17.447	103.05	13.00

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0780	131.08	17.454	148.95	12.75
NC0781	131.04	17.889	18.37	33.25
NC0782	130.98	18.082	18.37	33.25
NC0783	130.82	18.285	18.38	33.50
NC0784	130.77	18.364	18.38	33.25
NC0785	130.76	18.365	18.38	33.25
NC0787	130.71	18.410	112.61	17.25
NC0800	127.40	30.751	112.28	18.25
NC0820	124.92	67.615	33.99	14.75
NC0840	124.92	66.640	28.04	13.50
NC0860	124.92	66.517	59.42	12.25
NC0880	124.92	66.453	71.03	16.75
NC0882	127.18	31.788	35.39	13.75
NC0900	130.56	12.710	67.10	12.50
NC0912	130.46	12.746	64.20	12.50
NC0920	131.23	15.249	72.58	12.50
NC0925	129.91	13.297	82.07	12.75
NC0930	133.23	17.450	19.82	13.50
NC0935	131.24	15.258	80.11	12.25
NC0937	127.19	31.565	74.28	13.25
NC0940	135.23	15.067	11.01	13.00
NC0950	131.09	12.292	41.27	12.25
NC0955	127.19	31.681	41.13	12.25
NC0960	127.19	31.658	134.95	13.25
NC0960_S1	127.19	31.654	143.62	13.75
NC0960_S2	127.19	31.776	128.53	13.75
NC0980	127.19	31.654	18.14	13.75
NC1000	127.19	31.904	43.98	12.25
NC1020	127.19	31.772	135.41	12.50
NC1030	127.19	31.786	78.28	16.50
NC1035	127.19	31.809	21.00	12.00
NC1040	127.19	31.772	98.46	16.50
NC1050	127.19	31.771	112.59	16.50
NC1060	127.15	31.812	1308.90	29.75
NC1060_E	127.19	31.677	1327.34	29.25
NC1070	126.84	32.943	1307.59	29.75
NC1180	127.29	15.469	21.82	12.50
NC1190	126.76	33.212	4.19	15.50
NC1200	126.76	33.212	35.85	13.25
NC1210	126.76	33.267	1306.66	29.75

Lake Bonnet Drain

Alternative 2 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1220	126.46	35.328	178.85	12.50
NC1230	126.49	34.764	123.77	13.00
NC1360	126.49	34.784	1299.20	29.75
NC1362	126.05	38.181	1273.09	29.75
NC1380	126.43	35.481	22.16	13.00
NC1382	126.05	38.225	20.63	22.25
NH1042	130.29	29.917	0.00	0.00
NH1044	129.93	30.179	1122.38	29.75
NH1060	129.07	30.222	1122.16	30.00
NH1060_SA	130.00	12.953	77.03	12.25
NH1080	127.96	30.479	1123.24	30.00
NH1082	127.82	30.543	1123.01	30.25
NH1084	127.35	31.149	1123.02	30.25
SterlingCanal	143.43	14.826	265.37	16.75
SterlingCanal_East	143.43	14.814	228.92	17.50
SterlingCanal_N	144.00	13.551	53.11	13.50
WabashDS	142.92	14.029	375.70	14.50
WabashUS	143.27	14.443	341.36	15.00
WoodallDS	141.74	13.760	437.24	14.00
WoodallUS	142.56	13.856	437.02	13.75

APPENDIX B4

Alternative 3 Model Results

Lake Bonnet Drain
Alternative 3 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	140.94	15.936	10.82	29.50
BridgeBlvdDS	140.91	15.819	82.67	13.00
BridgeBlvdUS	140.92	15.872	91.45	12.75
BrunnellDS	140.92	16.017	10.82	29.50
ChestnutDS	135.59	15.666	77.21	15.75
ChestnutUS	140.75	15.660	77.48	15.50
Downstream TW	123.04	33.667	316.30	41.50
GolfcartDS	128.55	15.795	99.59	15.75
GolfcartUS	128.65	15.781	99.59	15.75
HowardDS	128.78	15.751	98.30	15.50
HowardUS	128.82	15.734	98.40	15.50
LAGOON	145.01	15.014	78.45	15.00
Lake Blanton_West	128.08	15.903	99.33	15.75
Lake bonnet	144.82	30.742	474.78	12.50
LakeBlanton_East	128.11	15.875	99.55	15.75
MayManorEast	140.92	15.939	75.07	12.50
MayManorEast_2	140.92	15.937	70.84	12.50
MayManorEast_3	140.92	15.935	61.14	12.50
MayManorHead	140.92	15.935	37.72	14.75
MayManorWest	140.92	15.956	64.07	12.50
MHPWEIRDS	140.87	15.755	39.12	16.25
MHPWeirUS	140.91	15.825	53.76	13.00
NC0020	195.94	15.535	22.96	15.50
NC0040	192.66	15.513	24.23	15.50
NC0060	199.74	12.467	17.21	12.50
NC0080	198.51	14.291	31.11	14.25
NC0090	187.43	15.062	56.32	15.00
NC0100	190.79	15.885	17.23	15.50
NC0120S	188.07	27.125	3.96	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.05	0.000	0.00	0.00
NC0120Sd	185.51	13.152	0.67	13.00
NC0140	168.93	12.642	17.94	12.50
NC0160	204.29	12.204	14.48	12.25
NC0180	196.05	12.485	34.19	12.50
NC0200	158.78	12.627	31.91	12.50
NC0240	142.45	15.669	23.51	15.50
NC0260	141.61	13.381	8.34	12.75
NC0300	149.66	13.464	16.23	13.50
NC0360	151.28	14.425	12.40	14.25
NC0365	147.84	14.530	12.29	14.50
NC0370	148.17	12.432	21.13	12.50
NC0380	144.29	12.385	39.58	12.50

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0382	142.97	12.435	39.74	12.50
NC0390	152.26	12.894	27.59	12.75
NC0398	140.84	15.702	49.92	15.75
NC0430	134.51	18.035	6.14	12.75
NC0440	134.50	18.273	11.11	13.00
NC0442	134.37	18.511	2.85	17.75
NC0460	130.95	15.532	96.21	15.50
NC0462	129.97	15.564	98.44	15.50
NC0480	127.35	15.890	99.92	16.00
NC0482	125.08	15.964	99.95	16.00
NC0500	132.47	13.717	5.86	13.50
NC0510	132.29	12.956	26.16	12.00
NC0520	129.87	13.206	36.62	12.25
NC0540	123.78	38.043	88.12	16.25
NC0540_E1	123.79	37.888	99.74	16.00
NC0540_E2	123.79	37.937	97.36	16.25
NC0540_E3	123.79	37.918	90.31	16.00
NC0540_E4	123.78	37.914	83.50	16.25
NC0540_E5	123.78	37.895	80.47	16.50
NC0560	123.97	0.000	4.61	17.25
NC0570	123.99	36.311	18.73	22.75
NC0572	123.82	18.035	99.96	16.00
NC0590	123.78	37.603	58.44	17.25
NC0620	126.13	16.093	3.65	15.75
NC0630	126.34	12.454	87.68	12.25
NC0631	123.78	37.775	57.79	17.25
NC0632	123.77	37.612	59.89	17.25
NC0635	123.77	37.814	418.11	17.25
NC0640	123.71	37.565	407.73	17.75
NC0650	123.65	37.764	398.61	18.25
NC0660	148.01	12.310	30.53	12.25
NC0670	137.50	13.114	30.41	12.25
NC0680	131.18	0.000	10.67	12.75
NC0700	128.00	13.093	13.86	13.00
NC0720	127.25	24.851	92.95	13.25
NC0722	127.19	24.243	27.21	13.25
NC0740	132.41	13.131	15.08	12.75
NC0760	128.74	13.143	27.77	13.00
NC0780	127.16	13.152	37.65	13.00
NC0781	127.08	13.164	9.50	13.25
NC0782	126.88	13.165	9.51	13.25
NC0783	126.03	13.183	9.54	13.25
NC0784	125.04	23.798	9.56	13.25
NC0785	124.97	23.801	9.57	13.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0787	124.89	23.752	28.59	12.50
NC0800	124.72	24.245	29.59	12.50
NC0820	123.20	59.750	11.24	14.75
NC0840	123.20	58.784	16.20	0.25
NC0860	123.20	58.379	16.10	12.25
NC0880	123.21	58.079	24.57	16.75
NC0882	123.61	37.808	15.21	18.00
NC0900	130.16	12.643	24.44	12.50
NC0912	129.67	12.792	23.70	12.75
NC0920	129.97	14.646	44.18	12.25
NC0925	129.29	13.358	34.11	12.75
NC0930	132.61	19.560	6.87	13.50
NC0935	129.97	14.657	25.98	12.25
NC0937	126.22	13.562	28.39	13.25
NC0940	134.47	15.679	1.88	13.25
NC0950	131.04	12.318	14.59	12.25
NC0955	125.72	12.342	14.04	12.25
NC0960	124.41	13.834	42.93	13.25
NC0960_S1	123.61	37.612	46.00	13.50
NC0960_S2	123.61	37.615	37.44	13.50
NC0980	124.31	13.917	3.91	14.00
NC1000	123.77	12.209	16.87	12.25
NC1020	123.61	37.770	63.53	13.00
NC1030	123.61	37.804	34.13	13.25
NC1035	123.72	12.133	7.98	12.00
NC1040	123.62	37.806	35.63	13.25
NC1050	123.62	37.678	39.22	13.25
NC1060	123.51	37.408	386.70	19.75
NC1060_E	123.62	37.708	396.00	18.50
NC1070	123.45	37.037	386.58	19.75
NC1180	126.56	17.725	6.52	12.50
NC1190	123.40	36.933	0.70	17.50
NC1200	123.40	36.933	3.92	22.25
NC1210	123.40	36.740	386.17	19.75
NC1220	123.21	35.954	66.40	12.50
NC1230	123.21	35.766	66.05	12.50
NC1360	123.21	35.416	376.74	19.75
NC1362	123.04	34.582	343.84	19.75
NC1380	123.85	13.587	5.07	13.50
NC1382	123.21	14.611	5.05	13.50
NH1042	127.53	17.167	0.00	0.00
NH1044	127.30	17.188	344.06	17.00
NH1060	126.55	17.432	344.03	17.00
NH1060_SA	128.66	12.509	27.36	12.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1080	124.02	37.568	355.87	16.75
NH1082	123.90	37.558	354.42	17.00
NH1084	123.80	37.782	353.39	17.00
SterlingCanal	140.92	15.870	119.57	12.75
SterlingCanal_East	140.92	15.913	93.22	12.75
SterlingCanal_N	142.50	13.533	16.23	13.50
Sump	140.90	15.879	46.13	22.00
WabashDS	140.85	15.732	49.87	15.75
WabashUS	140.86	15.720	41.05	16.00
WoodallDS	140.76	15.675	64.69	15.75
WoodallUS	140.81	15.679	64.67	15.75

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.17	15.019	35.70	27.00
BridgeBlvdDS	141.17	14.964	133.66	12.75
BridgeBlvdUS	141.17	14.967	150.49	12.75
BrunnellDS	141.16	14.983	35.70	27.00
ChestnutDS	136.38	14.491	132.72	14.50
ChestnutUS	140.86	14.483	132.49	14.50
Downstream TW	124.10	42.167	474.20	37.50
GolfcartDS	129.31	14.532	179.63	14.50
GolfcartUS	129.49	14.511	179.64	14.50
HowardDS	129.64	14.504	175.45	14.50
HowardUS	129.72	14.494	175.43	14.50
LAGOON	145.66	26.996	142.07	14.50
Lake Blanton_West	128.77	14.577	179.36	14.50
Lake bonnet	145.66	27.042	756.15	12.50
LakeBlanton_East	128.80	14.587	179.59	14.50
MayManorEast	141.16	14.995	134.18	12.50
MayManorEast_2	141.16	14.995	128.92	12.50
MayManorEast_3	141.16	15.003	116.89	12.50
MayManorHead	141.16	14.999	62.04	17.00
MayManorWest	141.17	15.000	114.66	12.50
MHPWEIRDS	141.11	14.814	54.54	15.25
MHPWeirUS	141.16	14.940	77.87	12.75
NC0020	196.68	15.442	39.61	15.50
NC0040	193.42	15.406	41.50	15.50
NC0060	204.02	14.087	27.54	12.50
NC0080	203.50	14.388	52.17	14.25
NC0090	188.69	14.819	103.76	14.75
NC0100	192.52	16.911	31.46	15.25
NC0120S	189.14	27.125	10.90	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.26	12.569	0.04	12.50
NC0120Sd	186.26	12.546	5.87	12.50
NC0140	169.65	12.636	28.96	12.50
NC0160	204.53	12.200	22.23	12.25
NC0180	199.08	12.513	53.41	12.50
NC0200	163.50	12.831	51.18	12.50
NC0240	142.62	15.636	38.87	15.50
NC0260	142.43	14.695	13.07	12.75
NC0300	150.15	13.424	27.94	13.50
NC0360	151.48	14.348	20.20	14.25
NC0365	148.16	14.435	20.07	14.25
NC0370	148.49	12.418	32.39	12.50
NC0380	145.26	12.403	65.35	12.50

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0382	144.86	12.410	65.84	12.50
NC0390	153.14	12.812	44.30	12.75
NC0398	141.06	14.699	75.58	15.00
NC0430	134.97	17.368	9.60	12.75
NC0440	134.95	18.043	17.02	13.00
NC0442	134.59	18.323	4.67	17.50
NC0460	131.89	14.363	172.33	14.25
NC0462	130.70	14.428	175.34	14.25
NC0480	127.83	14.592	181.46	14.50
NC0482	125.97	14.660	181.43	14.50
NC0500	132.99	13.987	8.98	13.25
NC0510	132.67	13.207	40.77	12.00
NC0520	130.18	12.720	54.42	12.25
NC0540	124.98	38.540	162.50	15.00
NC0540_E1	124.98	38.927	180.81	14.50
NC0540_E2	124.98	38.930	180.28	15.00
NC0540_E3	124.98	38.799	164.22	14.75
NC0540_E4	124.98	38.846	152.48	15.00
NC0540_E5	124.98	38.772	147.42	15.00
NC0560	124.97	39.369	9.09	15.25
NC0570	124.98	38.656	47.29	17.25
NC0572	124.98	38.880	181.35	14.50
NC0590	124.97	38.211	115.17	15.75
NC0620	126.32	16.483	5.36	15.75
NC0630	126.53	12.410	134.83	12.25
NC0631	124.97	38.213	113.89	15.75
NC0632	124.96	38.215	116.63	16.00
NC0635	124.96	38.222	567.19	16.50
NC0640	124.92	38.338	553.12	16.75
NC0650	124.77	39.096	540.74	17.25
NC0660	150.18	12.384	59.19	12.25
NC0670	137.77	12.456	55.95	12.50
NC0680	131.18	0.000	18.43	12.75
NC0700	129.13	24.474	25.85	13.00
NC0720	129.13	24.515	171.93	12.75
NC0722	128.89	23.234	37.05	13.00
NC0740	132.69	13.026	26.05	12.75
NC0760	130.24	13.292	51.38	13.00
NC0780	129.73	13.649	69.80	13.00
NC0781	129.38	13.616	21.15	13.75
NC0782	128.85	13.537	21.15	13.75
NC0783	127.57	13.204	21.16	13.75
NC0784	127.26	13.095	21.19	14.00
NC0785	127.13	13.052	21.20	14.00

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0787	126.81	12.918	54.80	12.50
NC0800	125.00	38.718	55.21	13.00
NC0820	123.78	59.750	19.13	14.75
NC0840	123.78	59.750	16.20	0.25
NC0860	123.79	59.750	29.62	12.25
NC0880	123.79	59.750	36.87	16.00
NC0882	124.73	39.477	20.53	16.00
NC0900	130.31	12.639	38.32	12.50
NC0912	129.99	12.756	37.06	12.50
NC0920	130.47	15.036	43.04	12.00
NC0925	129.54	13.378	49.26	12.75
NC0930	132.85	18.366	11.06	13.50
NC0935	130.47	15.046	45.58	12.25
NC0937	126.37	13.632	41.45	13.50
NC0940	134.75	15.198	4.42	13.00
NC0950	131.06	12.301	23.06	12.25
NC0955	125.85	12.268	22.93	12.25
NC0960	124.74	39.532	69.14	13.25
NC0960_S1	124.74	39.502	75.43	13.50
NC0960_S2	124.74	39.516	64.79	13.50
NC0980	124.74	39.566	8.10	13.75
NC1000	124.74	39.545	25.72	12.25
NC1020	124.74	39.522	84.99	12.50
NC1030	124.74	39.476	37.82	12.75
NC1035	124.74	39.622	12.17	12.00
NC1040	124.74	39.481	43.29	12.75
NC1050	124.75	39.104	51.90	12.75
NC1060	124.66	39.537	532.13	18.25
NC1060_E	124.75	39.118	537.25	17.50
NC1070	124.53	40.016	531.75	18.25
NC1180	126.81	16.123	11.39	12.50
NC1190	124.48	40.517	1.64	15.75
NC1200	124.48	40.517	16.22	17.25
NC1210	124.48	40.281	530.97	18.25
NC1220	124.30	41.575	103.05	12.50
NC1230	124.30	41.370	96.21	12.75
NC1360	124.30	41.215	508.43	19.25
NC1362	124.10	42.206	478.72	37.50
NC1380	124.21	13.622	7.73	13.50
NC1382	124.10	42.537	7.66	13.50
NH1042	128.51	34.667	0.00	0.00
NH1044	128.26	34.700	537.44	34.75
NH1060	127.36	34.845	537.53	34.75
NH1060_SA	129.28	12.657	43.59	12.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1080	125.30	36.483	537.50	34.75
NH1082	125.17	36.779	536.74	34.75
NH1084	124.99	37.934	536.41	34.75
SterlingCanal	141.17	15.003	200.20	12.75
SterlingCanal_East	141.17	14.998	162.11	12.50
SterlingCanal_N	142.98	13.456	27.95	13.50
Sump	141.12	14.989	93.13	21.75
WabashDS	141.09	14.709	75.53	15.00
WabashUS	141.10	14.708	58.22	15.25
WoodallDS	140.90	14.474	104.18	14.75
WoodallUS	141.02	14.672	104.05	14.75

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.59	25.825	58.98	25.75
BridgeBlvdDS	141.53	14.832	146.60	12.50
BridgeBlvdUS	141.55	15.040	172.41	12.50
BrunnellDS	141.55	15.065	58.98	25.75
ChestnutDS	137.04	14.413	184.29	14.50
ChestnutUS	140.94	14.428	184.29	14.25
Downstream TW	124.93	41.167	659.09	36.25
GolfcartDS	129.78	14.433	243.40	14.25
GolfcartUS	130.04	14.410	244.19	14.25
HowardDS	130.18	14.386	239.52	14.00
HowardUS	130.29	14.374	239.67	14.00
LAGOON	146.04	25.807	176.86	14.25
Lake Blanton_West	129.21	14.483	243.26	14.50
Lake bonnet	146.04	25.826	921.94	12.50
LakeBlanton_East	129.23	14.481	243.25	14.50
MayManorEast	141.54	15.047	146.59	12.25
MayManorEast_2	141.54	15.070	140.33	12.25
MayManorEast_3	141.54	15.068	121.95	12.25
MayManorHead	141.54	15.071	81.04	19.50
MayManorWest	141.55	15.047	122.68	12.25
MHPWEIRDS	141.45	14.651	86.81	15.50
MHPWeirUS	141.51	14.684	90.40	12.50
NC0020	197.09	15.396	49.85	15.50
NC0040	193.85	15.332	52.15	15.25
NC0060	204.40	13.094	33.71	12.50
NC0080	203.62	14.227	65.13	14.25
NC0090	189.24	14.784	126.30	14.75
NC0100	193.81	18.037	40.40	15.25
NC0120S	189.78	27.125	15.81	12.50
NC0120Sa	186.72	12.582	0.04	12.50
NC0120Sb	186.73	12.509	0.05	12.50
NC0120Sc	186.73	12.502	0.35	12.25
NC0120Sd	186.73	12.497	11.03	12.50
NC0140	170.29	12.657	35.54	12.50
NC0160	204.60	12.189	26.84	12.25
NC0180	199.16	12.499	65.13	12.50
NC0200	163.82	12.628	62.70	12.50
NC0240	142.68	15.502	48.19	15.50
NC0260	142.83	14.766	15.89	12.75
NC0300	150.40	13.409	35.10	13.50
NC0360	151.59	14.320	24.90	14.00
NC0365	148.31	14.396	24.80	14.25
NC0370	148.65	12.422	39.09	12.50
NC0380	145.44	12.385	79.52	12.50

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0382	144.96	12.346	80.21	12.50
NC0390	153.19	12.722	54.30	12.75
NC0398	141.36	14.650	112.34	15.00
NC0430	135.19	16.370	11.65	12.75
NC0440	135.15	17.799	20.43	13.25
NC0442	134.72	18.064	6.06	17.75
NC0460	132.52	13.974	236.18	14.00
NC0462	131.23	14.132	239.78	14.00
NC0480	128.15	14.475	246.55	14.50
NC0482	126.55	14.672	246.56	14.50
NC0500	133.18	13.985	10.85	13.25
NC0510	132.78	12.826	49.45	12.00
NC0520	130.36	12.714	64.88	12.00
NC0540	125.92	36.947	231.11	15.25
NC0540_E1	125.92	36.988	245.85	14.50
NC0540_E2	125.92	37.035	243.54	15.00
NC0540_E3	125.92	36.902	228.88	15.00
NC0540_E4	125.92	37.001	218.40	15.00
NC0540_E5	125.92	37.069	214.62	15.25
NC0560	125.91	38.200	12.57	14.50
NC0570	125.93	36.980	113.71	16.25
NC0572	125.92	37.033	246.50	14.50
NC0590	125.91	36.655	154.00	15.25
NC0620	126.42	16.657	6.39	15.75
NC0630	126.62	12.398	162.85	12.25
NC0631	125.91	36.657	152.25	15.25
NC0632	125.91	36.631	154.45	17.75
NC0635	125.91	36.579	754.36	32.50
NC0640	125.87	36.710	736.91	33.50
NC0650	125.73	37.369	732.99	33.75
NC0660	150.36	12.285	77.34	12.25
NC0670	137.79	12.232	77.03	12.25
NC0680	131.18	0.000	23.17	12.75
NC0700	130.07	24.053	33.37	13.00
NC0720	130.07	24.245	248.66	13.00
NC0722	130.06	24.181	38.80	12.75
NC0740	132.82	12.990	32.74	12.75
NC0760	130.34	13.041	65.98	13.00
NC0780	130.12	13.113	92.12	12.75
NC0781	129.89	13.078	22.84	25.00
NC0782	129.52	13.053	22.84	25.00
NC0783	128.55	13.000	22.84	25.00
NC0784	128.30	12.991	22.85	25.25
NC0785	128.19	12.988	22.85	25.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0787	127.91	12.973	67.92	12.25
NC0800	125.93	36.984	65.44	13.00
NC0820	124.14	59.750	23.64	14.75
NC0840	124.16	59.750	19.01	13.75
NC0860	124.16	59.750	38.03	12.25
NC0880	124.16	59.750	45.28	15.75
NC0882	125.69	37.608	24.89	15.25
NC0900	130.38	12.629	46.58	12.50
NC0912	130.15	12.740	45.19	12.50
NC0920	130.72	15.109	49.84	12.50
NC0925	129.67	13.355	58.80	12.75
NC0930	132.97	17.946	13.57	13.50
NC0935	130.72	15.119	56.08	12.25
NC0937	126.46	13.587	50.45	13.50
NC0940	134.90	15.107	6.19	13.00
NC0950	131.07	12.299	28.20	12.25
NC0955	125.90	12.256	28.07	12.25
NC0960	125.70	37.700	86.27	13.50
NC0960_S1	125.70	37.604	94.62	13.50
NC0960_S2	125.70	37.564	81.60	13.50
NC0980	125.70	37.605	10.86	13.75
NC1000	125.70	37.741	30.98	12.25
NC1020	125.70	37.625	94.04	13.25
NC1030	125.70	37.607	41.91	32.50
NC1035	125.70	37.674	14.66	12.00
NC1040	125.70	37.594	45.79	32.50
NC1050	125.70	37.431	57.78	12.50
NC1060	125.65	37.671	689.52	34.75
NC1060_E	125.71	37.427	731.33	33.75
NC1070	125.40	38.602	687.59	35.00
NC1180	126.95	15.866	14.36	12.50
NC1190	125.34	38.921	2.33	15.75
NC1200	125.34	38.920	31.86	16.00
NC1210	125.34	38.868	687.03	35.00
NC1220	125.17	40.211	124.86	12.50
NC1230	125.17	39.951	108.10	12.75
NC1360	125.17	39.731	677.13	35.50
NC1362	124.94	41.200	665.90	36.00
NC1380	124.93	41.984	9.32	13.50
NC1382	124.93	41.742	9.81	21.00
NH1042	129.23	32.417	0.00	0.00
NH1044	128.93	32.459	757.34	32.25
NH1060	128.02	32.765	757.16	32.25
NH1060_SA	129.52	12.750	53.27	12.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1080	126.39	34.691	756.99	32.50
NH1082	126.25	34.963	755.80	32.50
NH1084	125.94	36.466	755.37	32.50
SterlingCanal	141.55	15.065	231.23	12.50
SterlingCanal_East	141.55	15.059	182.06	12.50
SterlingCanal_N	143.23	13.440	35.11	13.50
Sump	141.50	15.037	93.40	14.50
WabashDS	141.41	14.648	112.29	15.00
WabashUS	141.43	14.649	91.14	15.25
WoodallDS	141.02	14.655	149.11	14.50
WoodallUS	141.29	14.655	149.42	14.50

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.60	16.291	124.59	24.75
BridgeBlvdDS	142.44	15.624	169.24	12.50
BridgeBlvdUS	142.48	15.741	207.24	12.50
BrunnellDS	142.50	15.757	124.59	24.75
ChestnutDS	138.26	14.084	313.81	14.00
ChestnutUS	141.11	14.094	314.19	14.00
Downstream TW	126.05	38.167	1146.07	31.75
GolfcartDS	130.66	14.579	394.37	14.50
GolfcartUS	131.12	14.559	397.65	14.25
HowardDS	131.17	14.541	395.97	14.00
HowardUS	131.44	14.447	397.34	14.00
LAGOON	146.86	24.847	287.49	12.75
Lake Blanton_West	130.02	14.635	393.93	14.50
Lake bonnet	146.85	24.854	1382.61	12.50
LakeBlanton_East	130.03	14.633	394.26	14.50
MayManorEast	142.49	15.718	135.71	12.25
MayManorEast_2	142.49	15.752	129.82	12.25
MayManorEast_3	142.49	15.711	160.76	21.50
MayManorHead	142.49	15.745	159.72	21.00
MayManorWest	142.48	15.705	109.25	12.00
MHPWEIRDS	142.27	15.514	184.54	16.25
MHPWeirUS	142.39	15.559	184.25	16.25
NC0020	201.49	16.142	75.77	15.25
NC0040	196.16	18.160	76.04	16.00
NC0060	204.66	12.605	49.01	12.50
NC0080	203.80	14.192	96.22	14.25
NC0090	190.38	14.540	172.46	14.50
NC0100	196.17	18.182	71.25	15.25
NC0120S	191.36	27.125	29.79	12.25
NC0120Sa	188.12	12.475	0.60	12.25
NC0120Sb	188.12	12.465	1.42	12.25
NC0120Sc	188.12	12.457	2.03	12.25
NC0120Sd	188.12	12.453	28.14	12.50
NC0140	174.63	12.642	51.90	12.50
NC0160	204.73	12.179	38.27	12.25
NC0180	199.28	12.491	94.26	12.50
NC0200	163.91	12.576	91.27	12.50
NC0240	142.81	15.519	71.57	15.50
NC0260	143.04	13.623	22.88	12.75
NC0300	150.99	13.384	53.11	13.50
NC0360	152.13	14.666	36.71	14.00
NC0365	148.60	14.732	35.26	14.75
NC0370	148.94	12.431	55.71	12.50
NC0380	145.83	12.423	115.23	12.50

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0382	145.14	12.411	116.31	12.50
NC0390	153.26	12.735	79.13	12.75
NC0398	142.00	15.255	215.24	15.50
NC0430	135.78	14.409	16.76	12.75
NC0440	135.37	16.497	27.25	13.25
NC0442	135.23	16.701	13.19	16.25
NC0460	133.72	13.893	393.30	13.75
NC0462	132.18	14.193	397.78	14.00
NC0480	128.78	14.614	399.51	14.50
NC0482	127.68	15.100	399.46	14.50
NC0500	133.49	13.991	15.50	13.25
NC0510	132.89	12.417	70.94	12.00
NC0520	130.59	12.393	114.51	12.25
NC0540	127.26	31.496	400.04	14.50
NC0540_E1	127.27	31.479	398.68	14.50
NC0540_E2	127.27	31.479	404.95	15.00
NC0540_E3	127.27	31.493	384.33	14.50
NC0540_E4	127.27	31.482	374.14	14.50
NC0540_E5	127.26	31.494	368.27	14.50
NC0560	127.26	31.913	22.39	13.00
NC0570	127.27	31.499	245.33	14.50
NC0572	127.27	31.508	399.32	14.50
NC0590	127.24	31.682	356.46	18.50
NC0620	127.25	31.575	8.96	15.75
NC0630	127.23	31.941	232.38	12.25
NC0631	127.24	31.720	354.63	18.50
NC0632	127.23	31.721	357.81	18.50
NC0635	127.23	31.600	1221.80	29.75
NC0640	127.19	31.931	1217.14	29.75
NC0650	127.15	31.931	1214.55	30.00
NC0660	150.56	12.269	123.88	12.25
NC0670	137.88	12.343	123.71	12.25
NC0680	131.18	0.000	35.05	12.75
NC0700	131.09	17.459	52.59	13.00
NC0720	131.09	17.464	419.16	12.75
NC0722	131.09	17.455	36.65	12.50
NC0740	133.08	12.897	49.52	12.75
NC0760	131.09	17.457	103.11	13.00
NC0780	131.08	17.461	148.96	12.75
NC0781	131.04	17.924	18.72	33.00
NC0782	130.97	18.202	18.73	33.00
NC0783	130.81	18.411	18.73	33.00
NC0784	130.76	18.462	18.73	33.00
NC0785	130.75	18.462	18.73	33.00

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0787	130.70	18.521	112.58	17.25
NC0800	127.27	31.448	110.67	18.50
NC0820	124.82	59.750	34.00	14.75
NC0840	124.84	59.750	28.05	13.50
NC0860	124.84	59.750	59.34	12.25
NC0880	124.84	59.750	69.57	16.50
NC0882	127.11	32.163	33.32	13.75
NC0900	130.56	12.714	67.07	12.50
NC0912	130.46	12.750	64.13	12.50
NC0920	131.23	15.253	72.55	12.50
NC0925	129.91	13.301	82.11	12.75
NC0930	133.23	17.454	19.82	13.50
NC0935	131.24	15.262	80.13	12.25
NC0937	127.12	32.039	74.27	13.25
NC0940	135.23	15.071	11.01	13.00
NC0950	131.09	12.296	41.22	12.25
NC0955	127.12	32.040	41.07	12.25
NC0960	127.12	32.096	134.57	13.25
NC0960_S1	127.12	32.066	143.04	13.75
NC0960_S2	127.11	32.091	128.56	13.75
NC0980	127.12	32.089	18.14	13.75
NC1000	127.11	32.357	44.03	12.25
NC1020	127.11	32.092	137.53	13.75
NC1030	127.11	32.162	61.01	14.50
NC1035	127.11	32.256	20.83	12.00
NC1040	127.11	32.040	50.48	18.50
NC1050	127.12	32.038	70.06	12.50
NC1060	127.08	32.191	1190.59	30.50
NC1060_E	127.12	32.038	1213.71	30.00
NC1070	126.73	33.401	1189.06	30.50
NC1180	127.29	15.473	21.83	12.50
NC1190	126.66	33.728	4.19	15.50
NC1200	126.66	33.728	61.45	14.50
NC1210	126.66	33.619	1188.09	30.75
NC1220	126.40	35.569	178.93	12.50
NC1230	126.43	35.124	123.76	13.00
NC1360	126.43	35.148	1175.48	31.00
NC1362	126.05	38.115	1153.51	31.25
NC1380	126.36	35.873	22.12	13.00
NC1382	126.05	38.224	20.63	22.25
NH1042	130.29	29.917	0.00	0.00
NH1044	129.92	30.180	1125.63	29.75
NH1060	129.05	30.247	1125.28	30.00
NH1060_SA	130.00	12.957	77.26	12.25

Lake Bonnet Drain

Alternative 3 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NH1080	127.91	30.802	1126.24	30.00
NH1082	127.78	30.915	1125.70	30.00
NH1084	127.27	31.570	1125.58	30.25
SterlingCanal	142.48	15.708	282.08	12.50
SterlingCanal_East	142.48	15.721	208.71	12.50
SterlingCanal_N	143.74	13.349	53.12	13.50
Sump	142.46	15.711	93.36	22.75
WabashDS	142.11	15.370	215.22	15.50
WabashUS	142.22	15.456	189.30	16.25
WoodallDS	141.31	14.411	259.13	14.75
WoodallUS	141.90	14.649	259.09	14.75

APPENDIX B5

Alternative 4 Model Results

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	141.38	15.791	25.04	26.50
BridgeBlvdDS	141.29	14.575	73.37	17.00
BridgeBlvdUS	141.34	15.239	62.83	12.50
BrunnellDS	141.37	15.791	25.04	26.50
ChestnutDS	136.42	14.046	136.84	14.00
ChestnutUS	140.87	14.044	136.99	13.75
Downstream TW	123.04	33.667	356.13	40.50
GolfcartDS	129.21	14.241	168.04	14.25
GolfcartUS	129.38	14.221	168.57	14.00
HowardDS	129.53	14.209	165.74	14.00
HowardUS	129.61	14.193	165.90	14.00
LAGOON	145.45	26.381	78.44	15.00
Lake Blanton_West	128.68	14.333	167.72	14.25
Lake bonnet	145.45	26.419	475.44	12.50
LakeBlanton_East	128.70	14.339	168.04	14.25
MayManorEast	141.35	15.373	43.95	17.50
MayManorEast_2	141.36	15.367	59.21	17.75
MayManorHead	141.37	15.632	38.95	17.75
MayManorWest	141.35	15.200	64.03	17.50
NC0020	195.94	15.544	22.96	15.50
NC0040	192.66	15.512	24.23	15.50
NC0060	199.74	12.462	17.19	12.50
NC0080	198.51	14.287	31.11	14.25
NC0090	187.43	15.055	56.32	15.00
NC0100	190.79	15.881	17.23	15.50
NC0120S	188.07	27.117	3.96	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.05	0.000	0.00	0.00
NC0120Sd	185.51	13.159	0.67	13.00
NC0140	168.93	12.638	17.97	12.50
NC0160	204.29	12.201	14.44	12.25
NC0180	196.05	12.484	34.18	12.50
NC0200	158.79	12.593	31.94	12.50
NC0240	141.60	17.272	21.45	17.00
NC0260	141.99	14.458	8.35	12.75
NC0300	149.66	13.456	16.23	13.50
NC0360	151.28	14.421	12.40	14.25
NC0365	147.84	14.526	12.29	14.50
NC0370	148.17	12.428	21.10	12.50

Lake Bonnet Drain
Alternative 4 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0380	144.29	12.383	39.52	12.50
NC0382	142.65	12.388	39.69	12.50
NC0390	152.23	12.832	27.59	12.75
NC0398	141.13	14.210	94.31	14.50
NC0430	134.51	18.029	6.14	12.75
NC0440	134.50	18.265	11.11	13.00
NC0442	134.37	18.504	2.85	17.75
NC0460	131.81	13.944	164.71	14.00
NC0462	130.61	14.043	165.95	14.00
NC0480	127.76	14.349	168.43	14.25
NC0482	126.49	14.357	168.37	14.25
NC0500	132.47	13.713	5.86	13.50
NC0510	132.29	12.952	26.40	12.00
NC0520	129.87	13.202	36.56	12.25
NC0540	124.00	35.354	143.42	15.00
NC0540_E1	124.01	35.334	168.21	14.25
NC0540_E2	124.01	35.236	239.78	14.25
NC0540_E3	124.01	35.440	158.86	15.25
NC0540_E4	124.01	35.312	138.78	15.00
NC0540_E5	124.01	35.314	133.69	15.25
NC0560	124.00	36.177	6.04	16.25
NC0570	124.14	31.182	20.24	22.50
NC0572	124.55	14.380	168.27	14.25
NC0590	123.95	35.913	104.16	16.50
NC0620	126.13	16.089	3.65	15.75
NC0630	126.34	12.450	87.93	12.25
NC0631	123.95	35.912	103.33	16.50
NC0632	123.94	35.913	105.23	16.50
NC0635	123.94	35.905	462.77	16.75
NC0640	123.87	36.184	451.07	17.50
NC0650	123.79	36.189	442.15	18.00
NC0660	148.01	12.305	30.57	12.25
NC0670	137.50	13.111	30.45	12.25
NC0680	131.18	0.000	10.67	12.75
NC0700	128.00	13.085	13.87	13.00
NC0720	127.25	24.846	92.91	13.25
NC0722	127.19	24.220	27.20	13.25
NC0740	132.41	13.126	15.08	12.75
NC0760	128.74	13.138	27.79	13.00
NC0780	127.16	13.148	37.64	13.00

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0781	127.08	13.157	9.49	13.25
NC0782	126.88	13.160	9.50	13.25
NC0783	126.03	13.179	9.53	13.25
NC0784	125.04	23.858	9.55	13.25
NC0785	124.97	23.776	9.56	13.25
NC0787	124.89	23.760	28.56	12.50
NC0800	124.72	24.241	29.61	12.50
NC0820	123.26	59.750	11.25	14.75
NC0840	123.27	59.750	16.20	0.25
NC0860	123.27	59.523	16.14	12.25
NC0880	123.27	59.358	25.86	16.75
NC0882	123.75	36.210	16.84	17.50
NC0900	130.16	12.638	24.46	12.50
NC0912	129.67	12.787	23.67	12.75
NC0920	129.97	14.642	44.36	12.25
NC0925	129.29	13.354	34.08	12.75
NC0930	132.61	19.556	6.87	13.50
NC0935	129.97	14.653	25.87	12.25
NC0937	126.22	13.557	28.39	13.25
NC0940	134.47	15.675	1.88	13.25
NC0950	131.04	12.314	14.61	12.25
NC0955	125.72	12.338	14.16	12.25
NC0960	124.41	13.831	42.94	13.25
NC0960_S1	123.75	36.228	46.00	13.50
NC0960_S2	123.75	36.209	37.45	13.50
NC0980	124.31	13.917	3.91	14.00
NC1000	123.77	12.201	16.86	12.25
NC1020	123.75	36.134	63.51	13.00
NC1030	123.75	36.198	38.24	15.25
NC1035	123.75	36.646	8.05	12.00
NC1040	123.75	36.192	44.02	15.25
NC1050	123.76	36.161	57.37	15.00
NC1060	123.63	35.802	430.13	19.75
NC1060_E	123.76	36.170	439.70	18.50
NC1070	123.56	35.706	429.99	19.75
NC1180	126.56	17.718	6.52	12.50
NC1190	123.50	35.844	0.70	17.50
NC1200	123.50	35.844	5.18	19.00
NC1210	123.49	35.622	429.54	19.75
NC1220	123.26	35.596	66.38	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 2.33-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1230	123.26	35.388	66.07	12.50
NC1360	123.26	34.751	418.58	20.00
NC1362	123.04	34.413	386.33	20.00
NC1380	123.85	13.582	5.07	13.50
NC1382	123.21	14.606	5.05	13.50
NH1042	127.53	17.167	0.00	0.00
NH1044	127.30	17.201	343.30	17.00
NH1060	126.56	17.455	343.27	17.00
NH1060_SA	128.66	12.505	27.29	12.25
NH1080	124.16	36.370	355.12	16.75
NH1082	124.06	36.334	353.66	17.00
NH1084	123.96	36.360	352.69	17.00
SterlingCanal	141.34	15.210	88.63	12.50
SterlingCanal_East	141.35	15.205	53.16	12.50
SterlingCanal_N	142.50	13.500	16.23	13.50
WabashDS	141.17	14.244	94.25	14.50
WabashUS	141.19	14.252	82.67	15.50
WoodallDS	140.92	14.128	115.37	14.25
WoodallUS	141.07	14.173	115.30	14.25

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.02	15.927	60.88	25.00
BridgeBlvdDS	141.84	14.091	112.22	17.00
BridgeBlvdUS	141.94	15.149	95.62	18.50
BrunnellDS	141.99	15.428	60.88	25.00
ChestnutDS	137.49	13.629	227.31	13.75
ChestnutUS	141.00	13.607	227.79	13.50
Downstream TW	124.10	42.167	548.83	37.25
GolfcartDS	129.98	14.223	275.18	14.25
GolfcartUS	130.29	14.209	277.32	14.00
HowardDS	130.40	14.181	276.15	13.75
HowardUS	130.53	14.129	276.44	13.75
LAGOON	146.07	24.983	142.09	14.50
Lake Blanton_West	129.40	14.280	274.97	14.25
Lake bonnet	146.07	24.995	756.59	12.50
LakeBlanton_East	129.42	14.277	275.24	14.25
MayManorEast	141.95	15.179	85.32	20.75
MayManorEast_2	141.95	15.128	106.80	20.00
MayManorHead	141.97	15.268	86.56	20.00
MayManorWest	141.94	15.124	104.56	21.25
NC0020	196.68	15.439	39.61	15.50
NC0040	193.42	15.391	41.49	15.25
NC0060	204.02	14.083	27.51	12.50
NC0080	203.50	14.391	52.18	14.25
NC0090	188.69	14.819	103.77	14.75
NC0100	192.52	16.907	31.46	15.25
NC0120S	189.14	27.117	10.88	12.50
NC0120Sa	186.61	0.000	0.00	0.00
NC0120Sb	186.45	0.000	0.00	0.00
NC0120Sc	186.26	12.565	0.03	12.50
NC0120Sd	186.26	12.542	5.87	12.50
NC0140	169.65	12.632	28.99	12.50
NC0160	204.53	12.196	22.17	12.25
NC0180	199.08	12.508	53.40	12.50
NC0200	163.56	12.824	51.23	12.50
NC0240	142.21	16.386	33.60	17.50
NC0260	142.81	14.907	13.08	12.75
NC0300	150.15	13.420	27.93	13.50
NC0360	151.48	14.343	20.20	14.25
NC0365	148.16	14.427	20.07	14.25
NC0370	148.49	12.414	32.34	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0380	145.20	12.438	65.25	12.50
NC0382	144.75	12.443	65.74	12.50
NC0390	153.12	12.813	44.30	12.75
NC0398	141.61	14.045	153.15	14.00
NC0430	134.97	17.366	9.59	12.75
NC0440	134.95	18.041	17.03	13.00
NC0442	134.59	18.309	4.67	17.50
NC0460	132.86	13.641	274.99	13.50
NC0462	131.51	13.829	276.56	13.75
NC0480	128.30	14.284	277.48	14.25
NC0482	127.42	14.303	277.46	14.25
NC0500	132.99	13.983	8.98	13.25
NC0510	132.67	13.203	41.11	12.00
NC0520	130.18	12.716	54.24	12.25
NC0540	125.26	37.862	250.01	14.75
NC0540_E1	125.27	37.781	277.39	14.25
NC0540_E2	125.27	37.849	473.22	15.50
NC0540_E3	125.26	37.801	268.24	15.00
NC0540_E4	125.26	37.778	242.33	14.75
NC0540_E5	125.26	37.827	236.95	15.00
NC0560	125.26	38.549	11.41	14.75
NC0570	125.26	37.864	77.81	17.25
NC0572	125.31	37.649	277.42	14.25
NC0590	125.20	37.504	189.93	15.25
NC0620	126.32	16.479	5.36	15.75
NC0630	126.53	12.406	135.17	12.25
NC0631	125.20	37.501	188.32	15.25
NC0632	125.19	37.502	190.10	15.50
NC0635	125.19	37.490	631.99	16.00
NC0640	125.14	37.647	619.34	18.75
NC0650	124.95	38.379	610.91	19.00
NC0660	150.18	12.380	59.23	12.25
NC0670	137.77	12.452	55.89	12.50
NC0680	131.18	0.000	18.44	12.75
NC0700	129.13	24.489	25.85	13.00
NC0720	129.13	24.508	171.89	12.75
NC0722	128.89	23.193	37.05	13.00
NC0740	132.69	13.022	26.05	12.75
NC0760	130.24	13.288	51.38	13.00
NC0780	129.73	13.645	69.74	13.00

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0781	129.38	13.615	21.15	13.75
NC0782	128.85	13.532	21.16	13.75
NC0783	127.57	13.201	21.16	13.75
NC0784	127.26	13.090	21.19	14.00
NC0785	127.13	13.044	21.20	14.00
NC0787	126.81	12.913	54.73	12.50
NC0800	125.27	37.878	55.20	13.00
NC0820	123.83	59.750	19.14	14.75
NC0840	123.84	59.750	16.20	0.25
NC0860	123.84	59.750	29.68	12.25
NC0880	123.84	59.750	37.88	16.00
NC0882	124.90	38.837	22.84	15.50
NC0900	130.31	12.635	38.34	12.50
NC0912	129.99	12.752	37.12	12.50
NC0920	130.47	15.032	41.68	12.00
NC0925	129.54	13.373	49.23	12.75
NC0930	132.85	18.361	11.06	13.50
NC0935	130.47	15.043	45.58	12.25
NC0937	126.37	13.623	41.44	13.50
NC0940	134.75	15.193	4.43	13.00
NC0950	131.06	12.297	23.09	12.25
NC0955	125.85	12.264	22.97	12.25
NC0960	124.91	38.849	69.15	13.25
NC0960_S1	124.91	38.891	75.23	13.50
NC0960_S2	124.91	38.901	62.49	13.50
NC0980	124.91	38.894	8.10	13.75
NC1000	124.91	38.993	25.69	12.25
NC1020	124.91	38.907	85.05	12.50
NC1030	124.91	38.836	37.70	12.75
NC1035	124.91	39.020	12.27	12.00
NC1040	124.91	38.841	43.21	12.75
NC1050	124.92	38.507	60.72	14.00
NC1060	124.82	38.889	601.75	19.75
NC1060_E	124.92	38.575	608.60	19.00
NC1070	124.65	39.479	601.21	19.75
NC1180	126.81	16.119	11.39	12.50
NC1190	124.59	39.990	1.64	15.75
NC1200	124.58	39.989	21.34	16.75
NC1210	124.58	39.927	600.58	19.75
NC1220	124.36	41.304	103.01	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 10-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1230	124.36	41.150	96.18	12.75
NC1360	124.36	40.893	580.56	20.25
NC1362	124.10	42.184	553.34	37.25
NC1380	124.21	13.618	7.73	13.50
NC1382	124.10	42.533	7.66	13.50
NH1042	128.51	34.667	0.00	0.00
NH1044	128.26	34.695	536.36	34.75
NH1060	127.38	34.854	536.43	34.75
NH1060_SA	129.28	12.653	43.47	12.25
NH1080	125.50	36.353	536.38	34.75
NH1082	125.39	36.722	535.71	34.75
NH1084	125.22	37.289	535.42	34.75
SterlingCanal	141.94	15.143	118.49	12.50
SterlingCanal_East	141.94	15.119	81.58	25.25
SterlingCanal_N	142.99	13.500	27.94	13.50
WabashDS	141.68	14.047	153.13	14.00
WabashUS	141.72	14.059	129.35	15.00
WoodallDS	141.12	13.891	188.58	14.00
WoodallUS	141.51	14.007	188.57	14.00

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	142.39	21.643	86.26	24.75
BridgeBlvdDS	142.20	14.510	142.25	16.00
BridgeBlvdUS	142.25	14.790	123.26	20.50
BrunnellDS	142.30	15.038	86.26	24.75
ChestnutDS	137.96	13.541	279.32	13.50
ChestnutUS	141.07	13.522	279.43	13.50
Downstream TW	124.93	41.167	759.59	35.25
GolfcartDS	130.33	14.301	334.04	14.25
GolfcartUS	130.72	14.261	337.28	14.00
HowardDS	130.79	14.246	338.05	13.50
HowardUS	130.96	14.171	339.12	13.50
LAGOON	146.42	24.620	176.85	14.25
Lake Blanton_West	129.72	14.349	333.74	14.25
Lake bonnet	146.41	24.628	927.04	12.50
LakeBlanton_East	129.74	14.337	333.98	14.25
MayManorEast	142.26	14.829	122.70	21.00
MayManorEast_2	142.27	14.857	137.72	21.00
MayManorHead	142.29	14.912	117.52	20.75
MayManorWest	142.26	14.829	141.21	21.50
NC0020	197.09	15.405	49.84	15.50
NC0040	193.85	15.334	52.15	15.25
NC0060	204.40	13.090	33.67	12.50
NC0080	203.62	14.221	65.13	14.25
NC0090	189.24	14.788	126.30	14.75
NC0100	193.81	18.033	40.40	15.25
NC0120S	189.78	27.117	15.78	12.50
NC0120Sa	186.72	12.578	0.04	12.50
NC0120Sb	186.73	12.504	0.04	12.25
NC0120Sc	186.73	12.497	0.34	12.25
NC0120Sd	186.73	12.494	11.01	12.50
NC0140	170.29	12.653	35.59	12.50
NC0160	204.60	12.186	26.77	12.25
NC0180	199.16	12.494	65.12	12.50
NC0200	163.82	12.612	62.75	12.50
NC0240	142.48	16.214	39.90	17.75
NC0260	142.94	14.077	15.90	12.75
NC0300	150.40	13.404	35.10	13.50
NC0360	151.59	14.316	24.91	14.00
NC0365	148.31	14.394	24.80	14.25
NC0370	148.65	12.418	39.03	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0380	145.42	12.402	79.41	12.50
NC0382	144.91	12.414	79.95	12.50
NC0390	153.16	12.755	54.30	12.75
NC0398	141.86	14.246	189.23	14.25
NC0430	135.19	16.365	11.65	12.75
NC0440	135.15	17.795	20.42	13.25
NC0442	134.72	18.063	6.05	17.50
NC0460	133.34	13.575	337.84	13.50
NC0462	131.91	13.805	340.26	13.50
NC0480	128.56	14.348	336.91	14.25
NC0482	127.86	14.330	336.86	14.25
NC0500	133.18	13.981	10.86	13.25
NC0510	132.78	12.822	49.86	12.00
NC0520	130.36	12.709	65.32	12.00
NC0540	126.16	35.974	324.98	15.00
NC0540_E1	126.17	36.139	336.33	14.25
NC0540_E2	126.17	35.916	554.85	14.75
NC0540_E3	126.17	35.983	319.20	14.25
NC0540_E4	126.17	35.943	311.07	14.75
NC0540_E5	126.17	36.011	307.59	15.00
NC0560	126.16	37.008	14.16	14.25
NC0570	126.17	36.009	154.26	15.75
NC0572	126.19	35.912	336.81	14.25
NC0590	126.10	35.950	225.75	17.50
NC0620	126.42	16.653	6.39	15.75
NC0630	126.62	12.394	163.27	12.25
NC0631	126.10	35.878	224.11	17.50
NC0632	126.09	35.858	226.73	17.50
NC0635	126.09	35.882	846.64	33.00
NC0640	126.05	35.923	839.60	33.00
NC0650	125.94	36.446	836.04	33.00
NC0660	150.36	12.282	77.38	12.25
NC0670	137.79	12.228	77.10	12.25
NC0680	131.18	0.000	23.18	12.75
NC0700	130.09	24.446	33.38	13.00
NC0720	130.09	24.414	248.65	13.00
NC0722	130.08	24.388	38.81	12.75
NC0740	132.82	12.986	32.74	12.75
NC0760	130.34	13.037	65.96	13.00
NC0780	130.12	13.109	92.16	12.75

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0781	129.89	13.079	21.96	25.75
NC0782	129.52	13.049	21.96	25.75
NC0783	128.55	12.997	21.96	25.50
NC0784	128.30	12.983	21.96	25.50
NC0785	128.19	12.984	21.96	25.50
NC0787	127.91	12.969	68.12	12.25
NC0800	126.17	36.013	65.44	13.00
NC0820	124.19	60.000	23.64	14.75
NC0840	124.20	60.000	19.01	13.75
NC0860	124.21	60.000	38.10	12.25
NC0880	124.21	60.000	45.94	15.75
NC0882	125.90	36.597	26.73	14.75
NC0900	130.38	12.624	46.60	12.50
NC0912	130.15	12.736	45.27	12.50
NC0920	130.72	15.105	49.87	12.50
NC0925	129.67	13.351	58.76	12.75
NC0930	132.97	17.941	13.57	13.50
NC0935	130.72	15.115	56.07	12.25
NC0937	126.46	13.573	50.44	13.50
NC0940	134.90	15.102	6.20	13.00
NC0950	131.07	12.294	28.23	12.25
NC0955	125.91	36.703	28.11	12.25
NC0960	125.91	36.686	86.28	13.50
NC0960_S1	125.91	36.773	94.23	13.50
NC0960_S2	125.91	36.783	79.71	13.75
NC0980	125.91	36.773	10.86	13.75
NC1000	125.90	36.804	30.94	12.25
NC1020	125.90	36.740	92.65	12.50
NC1030	125.90	36.596	42.41	14.75
NC1035	125.91	36.747	14.78	12.00
NC1040	125.91	36.600	45.99	31.25
NC1050	125.91	36.555	66.67	13.25
NC1060	125.85	36.730	792.46	34.00
NC1060_E	125.91	36.502	834.35	33.00
NC1070	125.52	37.921	790.25	34.25
NC1180	126.95	15.862	14.36	12.50
NC1190	125.45	38.468	2.33	15.75
NC1200	125.45	38.468	36.40	15.75
NC1210	125.45	38.380	789.63	34.25
NC1220	125.23	39.849	124.80	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 25-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1230	125.23	39.703	108.12	12.75
NC1360	125.23	39.455	779.55	34.75
NC1362	124.94	41.216	767.48	35.00
NC1380	124.93	41.983	9.32	13.50
NC1382	124.93	41.742	9.81	21.00
NH1042	129.23	32.417	0.00	0.00
NH1044	128.93	32.446	752.65	32.25
NH1060	128.05	32.740	752.47	32.25
NH1060_SA	129.52	12.745	53.12	12.25
NH1080	126.56	34.349	752.36	32.50
NH1082	126.43	34.686	751.41	32.50
NH1084	126.12	35.696	751.07	32.50
SterlingCanal	142.25	14.816	135.65	12.50
SterlingCanal_East	142.25	14.832	108.89	22.00
SterlingCanal_N	143.26	13.506	35.11	13.50
WabashDS	141.95	14.312	189.26	14.25
WabashUS	142.02	14.391	164.13	15.00
WoodallDS	141.23	13.804	230.18	14.25
WoodallUS	141.75	14.146	230.09	14.25

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	143.40	22.134	154.15	24.25
BridgeBlvdDS	142.91	14.805	241.14	21.75
BridgeBlvdUS	142.94	14.845	223.51	22.25
BrunnellDS	143.05	16.534	154.15	24.25
ChestnutDS	139.02	13.624	409.81	13.50
ChestnutUS	141.21	13.609	410.36	13.50
Downstream TW	126.05	38.167	1280.02	31.00
GolfcartDS	131.08	14.626	475.06	14.50
GolfcartUS	131.70	14.598	483.44	14.00
HowardDS	131.73	14.587	488.96	13.75
HowardUS	132.12	14.446	495.74	13.75
LAGOON	147.18	24.159	287.47	12.75
Lake Blanton_West	130.42	14.675	474.65	14.75
Lake bonnet	147.17	24.167	1351.02	12.50
LakeBlanton_East	130.44	14.674	474.83	14.50
MayManorEast	142.95	15.877	214.51	21.75
MayManorEast_2	142.96	15.912	222.68	21.50
MayManorHead	143.00	16.243	202.54	21.50
MayManorWest	142.95	14.897	227.15	20.75
NC0020	201.49	16.138	75.77	15.25
NC0040	196.16	18.156	76.04	16.00
NC0060	204.66	12.601	48.95	12.50
NC0080	203.80	14.186	96.21	14.25
NC0090	190.38	14.541	172.47	14.50
NC0100	196.17	18.178	71.25	15.25
NC0120S	191.36	27.117	29.88	12.25
NC0120Sa	188.12	12.471	0.58	12.25
NC0120Sb	188.12	12.459	1.38	12.25
NC0120Sc	188.12	12.453	1.97	12.25
NC0120Sd	188.12	12.449	28.09	12.50
NC0140	174.63	12.638	51.96	12.50
NC0160	204.73	12.173	38.17	12.25
NC0180	199.28	12.486	94.23	12.50
NC0200	163.91	12.571	91.34	12.50
NC0240	143.01	16.316	54.24	18.50
NC0260	143.08	13.355	22.89	12.75
NC0300	150.99	13.385	53.09	13.50
NC0360	152.13	14.662	36.72	14.00
NC0365	148.60	14.728	35.26	14.75
NC0370	148.94	12.426	55.62	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0380	145.84	12.431	115.07	12.50
NC0382	145.17	12.455	116.08	12.50
NC0390	153.26	12.762	79.11	12.75
NC0398	142.36	14.044	278.79	14.50
NC0430	135.78	14.405	16.75	12.75
NC0440	135.37	16.493	27.24	13.25
NC0442	135.23	16.698	13.19	16.25
NC0460	134.55	13.624	494.89	13.50
NC0462	132.51	14.247	498.57	13.75
NC0480	129.22	14.704	480.06	14.75
NC0482	128.75	14.718	480.10	14.75
NC0500	133.49	13.987	15.51	13.25
NC0510	132.89	12.413	71.53	12.00
NC0520	130.59	12.389	114.95	12.25
NC0540	127.42	30.515	477.08	14.00
NC0540_E1	127.43	30.455	479.35	14.75
NC0540_E2	127.43	30.413	574.58	19.50
NC0540_E3	127.43	30.413	458.21	14.25
NC0540_E4	127.42	30.466	447.08	14.25
NC0540_E5	127.42	30.524	440.31	14.25
NC0560	127.42	30.847	26.34	12.75
NC0570	127.42	30.497	272.32	14.00
NC0572	127.44	30.379	480.12	14.75
NC0590	127.35	30.920	426.35	18.25
NC0620	127.36	30.912	8.96	15.75
NC0630	127.33	31.291	232.95	12.25
NC0631	127.34	30.957	424.33	18.25
NC0632	127.34	31.149	427.03	18.25
NC0635	127.33	31.051	1361.25	29.25
NC0640	127.29	31.222	1356.89	29.25
NC0650	127.24	31.383	1354.93	29.25
NC0660	150.56	12.267	123.90	12.25
NC0670	137.88	12.339	123.75	12.25
NC0680	131.18	0.000	35.06	12.75
NC0700	131.09	17.455	52.59	13.00
NC0720	131.09	17.458	419.37	12.75
NC0722	131.09	17.446	36.59	12.50
NC0740	133.08	12.893	49.51	12.75
NC0760	131.09	17.448	103.05	13.00
NC0780	131.08	17.456	148.95	12.75

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0781	131.04	17.906	18.31	33.25
NC0782	130.97	18.097	18.31	33.25
NC0783	130.81	18.374	18.32	33.50
NC0784	130.77	18.409	18.32	33.50
NC0785	130.75	18.422	18.32	33.25
NC0787	130.70	18.459	112.59	17.25
NC0800	127.42	30.463	111.49	18.50
NC0820	124.85	59.750	33.99	14.75
NC0840	124.86	59.750	28.04	13.50
NC0860	124.86	59.750	59.42	12.25
NC0880	124.87	59.750	70.28	16.75
NC0882	127.20	31.602	34.79	13.75
NC0900	130.56	12.710	67.10	12.50
NC0912	130.46	12.746	64.20	12.50
NC0920	131.23	15.249	72.58	12.50
NC0925	129.91	13.297	82.07	12.75
NC0930	133.23	17.449	19.82	13.50
NC0935	131.24	15.258	80.11	12.25
NC0937	127.21	31.549	74.28	13.25
NC0940	135.23	15.067	11.01	13.00
NC0950	131.09	12.292	41.27	12.25
NC0955	127.20	31.536	41.13	12.25
NC0960	127.20	31.540	134.88	13.25
NC0960_S1	127.20	31.649	143.58	13.75
NC0960_S2	127.20	31.482	128.79	13.75
NC0980	127.20	31.649	18.14	13.75
NC1000	127.20	31.755	43.98	12.25
NC1020	127.20	31.576	135.74	13.75
NC1030	127.20	31.601	61.98	13.50
NC1035	127.20	31.658	21.00	12.00
NC1040	127.20	31.585	66.76	12.75
NC1050	127.20	31.525	99.06	12.75
NC1060	127.16	31.692	1334.55	29.75
NC1060_E	127.20	31.439	1354.34	29.25
NC1070	126.86	32.684	1333.31	29.75
NC1180	127.29	15.469	21.82	12.50
NC1190	126.78	33.031	4.19	15.50
NC1200	126.78	33.030	65.32	14.50
NC1210	126.78	33.000	1332.31	30.00
NC1220	126.46	35.254	178.85	12.50

Lake Bonnet Drain

Alternative 4 Node Max Stage and Flow - 100-Yr, 24 Hours Storm Event

Node Name	Maximum Stage [ft]	Time to Max Stage [hrs]	Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1230	126.50	34.681	123.77	13.00
NC1360	126.50	34.691	1317.76	30.00
NC1362	126.05	38.166	1290.46	30.25
NC1380	126.44	35.388	22.16	13.00
NC1382	126.05	38.197	20.63	22.25
NH1042	130.29	29.917	0.00	0.00
NH1044	129.93	30.164	1121.86	29.75
NH1060	129.07	30.221	1121.61	30.00
NH1060_SA	130.00	12.953	77.03	12.25
NH1080	127.96	30.480	1122.70	30.00
NH1082	127.83	30.561	1122.47	30.00
NH1084	127.37	31.083	1122.38	30.25
SterlingCanal	142.94	14.873	224.00	22.50
SterlingCanal_East	142.94	14.855	207.01	23.00
SterlingCanal_N	143.83	13.524	53.11	13.50
WabashDS	142.51	14.108	278.75	14.50
WabashUS	142.68	14.288	249.24	16.75
WoodallDS	141.52	13.904	339.76	14.00
WoodallUS	142.24	13.990	339.72	14.00

APPENDIX C

MODEL RESULTS NODE STAGE AND FLOW COMPARISON

APPENDIX C1

Existing Condition vs Alternative 1 Model Results

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.07	-1.162	0.32	0.00
BridgeBlvdDS	0.01	-1.548	**31.20**	-0.75
BridgeBlvdUS	0.01	-1.488	**27.03**	-1.00
BrunnellDS	0.00	-1.431	0.30	0.00
ChestnutDS	0.54	-0.484	**93.50**	-0.50
ChestnutUS	0.08	-0.551	**93.51**	-0.50
Downstream TW	0.00	0.000	-27.14	**1.75**
ExMHPWeir	------	------	------	------
GolfcartDS	0.34	-0.144	**67.38**	-0.25
GolfcartUS	0.54	-0.182	**71.27**	-0.25
HowardDS	0.53	-0.159	**74.87**	-0.25
HowardUS	0.62	-0.197	**84.44**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.35	-0.140	**67.34**	-0.25
Lake bonnet	-0.01	-0.012	-0.14	0.00
LakeBlanton_East	0.36	-0.151	**67.23**	-0.25
MayManorEast	0.03	-1.413	**5.32**	0.00
MayManorEast_2	0.02	-1.396	**5.27**	-2.75
MayManorHead	0.02	-1.398	**2.03**	-1.75
MayManorWest	0.03	-1.408	**15.96**	-0.25
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	0.000	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 1 Model Results

2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	0.02	-1.387	0.00	0.00
NC0260	0.02	-1.397	0.85	-0.25
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	0.000	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	-0.001	-0.01	0.00
NC0382	0.04	0.002	-0.02	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.23	-1.529	**53.03**	-1.25
NC0430	0.00	0.003	0.00	0.00
NC0440	0.00	-0.021	0.00	0.00
NC0442	0.00	-0.031	0.05	0.00
NC0460	0.20	-0.087	**94.90**	-0.50
NC0462	0.44	-0.042	**92.64**	-0.25
NC0480	0.56	-0.168	**67.05**	-0.25
NC0482	0.94	-1.056	**66.97**	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	-0.01	0.00
NC0540	-0.03	0.449	**61.54**	-4.00
NC0540_E1	-0.02	0.589	**67.39**	-0.25
NC0540_E2	-0.03	0.615	**145.42**	-5.00
NC0540_E3	-0.03	0.548	**75.47**	0.00
NC0540_E4	-0.03	0.647	**66.09**	-0.25
NC0540_E5	-0.02	0.654	**64.99**	-0.25
NC0560	-0.02	0.571	**1.31**	0.00
NC0570	-0.02	0.569	**50.26**	0.00
NC0572	-0.02	0.560	**67.04**	-0.25
NC0590	-0.01	0.329	**48.76**	-1.00
NC0620	-0.02	0.306	0.00	0.00
NC0630	-0.02	0.249	0.00	0.00
NC0631	-0.02	0.395	**49.03**	-1.00
NC0632	-0.01	0.275	**49.85**	-1.00
NC0635	-0.02	0.287	-20.53	0.00
NC0640	-0.02	0.272	-24.37	0.50
NC0650	-0.02	0.221	-24.08	0.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 1 Model Results

2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	**3.36**	0.00
NC0720	0.00	-0.003	0.00	0.00
NC0722	0.00	0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.003	0.00	0.00
NC0780	0.00	-0.003	0.00	0.00
NC0781	0.00	0.013	0.05	0.00
NC0782	0.01	-0.066	0.04	-0.25
NC0783	0.01	-0.043	0.04	-0.25
NC0784	0.00	-0.020	0.05	0.00
NC0785	0.01	-0.052	0.05	0.00
NC0787	0.00	-0.044	0.04	0.00
NC0800	-0.03	0.569	0.82	-0.25
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.05	-6.935	0.00	0.00
NC0860	-0.05	-6.823	0.00	0.00
NC0880	-0.05	-6.758	0.42	0.00
NC0882	-0.01	0.220	**1.22**	-0.25
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.294	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.173	0.00	0.00
NC0960	-0.01	0.185	0.06	0.00
NC0960_S1	-0.01	0.290	0.17	0.00
NC0960_S2	-0.02	0.327	0.07	0.00
NC0980	-0.01	0.290	0.00	0.00
NC1000	-0.02	0.300	0.00	0.00
NC1020	-0.02	0.288	**2.13**	-1.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.02	0.317	**10.78**	-0.25
NC1035	-0.02	0.296	0.00	0.00
NC1040	-0.02	0.350	**12.80**	-0.25
NC1050	-0.01	0.346	**13.70**	-0.25
NC1060	-0.02	0.327	-24.33	0.00
NC1060_E	-0.01	0.351	-24.16	0.00
NC1070	-0.02	0.443	-24.31	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.02	0.518	0.00	0.00
NC1200	-0.02	0.518	**31.30**	**1.25**
NC1210	-0.02	0.373	-24.34	0.00
NC1220	-0.01	0.162	0.00	0.00
NC1230	-0.01	0.095	0.00	0.00
NC1360	-0.01	0.044	-30.70	0.25
NC1362	0.00	0.069	-30.17	0.50
NC1380	0.00	0.175	0.00	0.00
NC1382	0.00	0.003	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.022	0.61	0.00
NH1060	0.00	0.006	0.61	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	-0.01	0.151	0.59	0.00
NH1082	-0.01	0.095	0.48	0.00
NH1084	-0.01	0.165	0.48	0.00
SterlingCanal	0.02	-1.461	**26.22**	0.00
SterlingCanal_East	0.03	-1.458	**19.91**	-1.50
SterlingCanal_N	0.14	-0.087	0.00	0.00
WabashDS	0.28	-1.681	**52.94**	-1.25
WabashUS	0.35	-1.392	**42.43**	-1.50
WoodallDS	0.17	-0.552	**72.50**	-0.75
WoodallUS	0.23	-0.715	**72.42**	-0.75

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.07	-1.162	0.32	0.00
BridgeBlvdDS	0.01	-1.548	**31.20**	-0.75
BridgeBlvdUS	0.01	-1.488	**27.03**	-1.00
BrunnellDS	0.00	-1.431	0.30	0.00
ChestnutDS	0.54	-0.484	**93.50**	-0.50
ChestnutUS	0.08	-0.551	**93.51**	-0.50
Downstream TW	0.00	0.000	-27.14	**1.75**
ExMHPWeir	------	------	------	------
GolfcartDS	0.34	-0.144	**67.38**	-0.25
GolfcartUS	0.54	-0.182	**71.27**	-0.25
HowardDS	0.53	-0.159	**74.87**	-0.25
HowardUS	0.62	-0.197	**84.44**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.35	-0.140	**67.34**	-0.25
Lake bonnet	-0.01	-0.012	-0.14	0.00
LakeBlanton_East	0.36	-0.151	**67.23**	-0.25
MayManorEast	0.03	-1.413	**5.32**	0.00
MayManorEast_2	0.02	-1.396	**5.27**	-2.75
MayManorHead	0.02	-1.398	**2.03**	-1.75
MayManorWest	0.03	-1.408	**15.96**	-0.25
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	0.000	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	0.02	-1.387	0.00	0.00
NC0260	0.02	-1.397	0.85	-0.25
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	0.000	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	-0.001	-0.01	0.00
NC0382	0.04	0.002	-0.02	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.23	-1.529	**53.03**	-1.25
NC0430	0.00	0.003	0.00	0.00
NC0440	0.00	-0.021	0.00	0.00
NC0442	0.00	-0.031	0.05	0.00
NC0460	0.20	-0.087	**94.90**	-0.50
NC0462	0.44	-0.042	**92.64**	-0.25
NC0480	0.56	-0.168	**67.05**	-0.25
NC0482	0.94	-1.056	**66.97**	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	-0.01	0.00
NC0540	-0.03	0.449	**61.54**	-4.00
NC0540_E1	-0.02	0.589	**67.39**	-0.25
NC0540_E2	-0.03	0.615	**145.42**	-5.00
NC0540_E3	-0.03	0.548	**75.47**	0.00
NC0540_E4	-0.03	0.647	**66.09**	-0.25
NC0540_E5	-0.02	0.654	**64.99**	-0.25
NC0560	-0.02	0.571	**1.31**	0.00
NC0570	-0.02	0.569	**50.26**	0.00
NC0572	-0.02	0.560	**67.04**	-0.25
NC0590	-0.01	0.329	**48.76**	-1.00
NC0620	-0.02	0.306	0.00	0.00
NC0630	-0.02	0.249	0.00	0.00
NC0631	-0.02	0.395	**49.03**	-1.00
NC0632	-0.01	0.275	**49.85**	-1.00
NC0635	-0.02	0.287	-20.53	0.00
NC0640	-0.02	0.272	-24.37	0.50
NC0650	-0.02	0.221	-24.08	0.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	**3.36**	0.00
NC0720	0.00	-0.003	0.00	0.00
NC0722	0.00	0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.003	0.00	0.00
NC0780	0.00	-0.003	0.00	0.00
NC0781	0.00	0.013	0.05	0.00
NC0782	0.01	-0.066	0.04	-0.25
NC0783	0.01	-0.043	0.04	-0.25
NC0784	0.00	-0.020	0.05	0.00
NC0785	0.01	-0.052	0.05	0.00
NC0787	0.00	-0.044	0.04	0.00
NC0800	-0.03	0.569	0.82	-0.25
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.05	-6.935	0.00	0.00
NC0860	-0.05	-6.823	0.00	0.00
NC0880	-0.05	-6.758	0.42	0.00
NC0882	-0.01	0.220	**1.22**	-0.25
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.294	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.173	0.00	0.00
NC0960	-0.01	0.185	0.06	0.00
NC0960_S1	-0.01	0.290	0.17	0.00
NC0960_S2	-0.02	0.327	0.07	0.00
NC0980	-0.01	0.290	0.00	0.00
NC1000	-0.02	0.300	0.00	0.00
NC1020	-0.02	0.288	**2.13**	-1.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.02	0.317	**10.78**	-0.25
NC1035	-0.02	0.296	0.00	0.00
NC1040	-0.02	0.350	**12.80**	-0.25
NC1050	-0.01	0.346	**13.70**	-0.25
NC1060	-0.02	0.327	-24.33	0.00
NC1060_E	-0.01	0.351	-24.16	0.00
NC1070	-0.02	0.443	-24.31	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.02	0.518	0.00	0.00
NC1200	-0.02	0.518	**31.30**	**1.25**
NC1210	-0.02	0.373	-24.34	0.00
NC1220	-0.01	0.162	0.00	0.00
NC1230	-0.01	0.095	0.00	0.00
NC1360	-0.01	0.044	-30.70	0.25
NC1362	0.00	0.069	-30.17	0.50
NC1380	0.00	0.175	0.00	0.00
NC1382	0.00	0.003	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.022	0.61	0.00
NH1060	0.00	0.006	0.61	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	-0.01	0.151	0.59	0.00
NH1082	-0.01	0.095	0.48	0.00
NH1084	-0.01	0.165	0.48	0.00
SterlingCanal	0.02	-1.461	**26.22**	0.00
SterlingCanal_East	0.03	-1.458	**19.91**	-1.50
SterlingCanal_N	0.14	-0.087	0.00	0.00
WabashDS	0.28	-1.681	**52.94**	-1.25
WabashUS	0.35	-1.392	**42.43**	-1.50
WoodallDS	0.17	-0.552	**72.50**	-0.75
WoodallUS	0.23	-0.715	**72.42**	-0.75

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.07	-1.162	0.32	0.00
BridgeBlvdDS	0.01	-1.548	**31.20**	-0.75
BridgeBlvdUS	0.01	-1.488	**27.03**	-1.00
BrunnellDS	0.00	-1.431	0.30	0.00
ChestnutDS	0.54	-0.484	**93.50**	-0.50
ChestnutUS	0.08	-0.551	**93.51**	-0.50
Downstream TW	0.00	0.000	-27.14	**1.75**
ExMHPWeir	------	------	------	------
GolfcartDS	0.34	-0.144	**67.38**	-0.25
GolfcartUS	0.54	-0.182	**71.27**	-0.25
HowardDS	0.53	-0.159	**74.87**	-0.25
HowardUS	0.62	-0.197	**84.44**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.35	-0.140	**67.34**	-0.25
Lake bonnet	-0.01	-0.012	-0.14	0.00
LakeBlanton_East	0.36	-0.151	**67.23**	-0.25
MayManorEast	0.03	-1.413	**5.32**	0.00
MayManorEast_2	0.02	-1.396	**5.27**	-2.75
MayManorHead	0.02	-1.398	**2.03**	-1.75
MayManorWest	0.03	-1.408	**15.96**	-0.25
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	0.000	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	0.02	-1.387	0.00	0.00
NC0260	0.02	-1.397	0.85	-0.25
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	0.000	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	-0.001	-0.01	0.00
NC0382	0.04	0.002	-0.02	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.23	-1.529	**53.03**	-1.25
NC0430	0.00	0.003	0.00	0.00
NC0440	0.00	-0.021	0.00	0.00
NC0442	0.00	-0.031	0.05	0.00
NC0460	0.20	-0.087	**94.90**	-0.50
NC0462	0.44	-0.042	**92.64**	-0.25
NC0480	0.56	-0.168	**67.05**	-0.25
NC0482	0.94	-1.056	**66.97**	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	-0.01	0.00
NC0540	-0.03	0.449	**61.54**	-4.00
NC0540_E1	-0.02	0.589	**67.39**	-0.25
NC0540_E2	-0.03	0.615	**145.42**	-5.00
NC0540_E3	-0.03	0.548	**75.47**	0.00
NC0540_E4	-0.03	0.647	**66.09**	-0.25
NC0540_E5	-0.02	0.654	**64.99**	-0.25
NC0560	-0.02	0.571	**1.31**	0.00
NC0570	-0.02	0.569	**50.26**	0.00
NC0572	-0.02	0.560	**67.04**	-0.25
NC0590	-0.01	0.329	**48.76**	-1.00
NC0620	-0.02	0.306	0.00	0.00
NC0630	-0.02	0.249	0.00	0.00
NC0631	-0.02	0.395	**49.03**	-1.00
NC0632	-0.01	0.275	**49.85**	-1.00
NC0635	-0.02	0.287	-20.53	0.00
NC0640	-0.02	0.272	-24.37	0.50
NC0650	-0.02	0.221	-24.08	0.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	**3.36**	0.00
NC0720	0.00	-0.003	0.00	0.00
NC0722	0.00	0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.003	0.00	0.00
NC0780	0.00	-0.003	0.00	0.00
NC0781	0.00	0.013	0.05	0.00
NC0782	0.01	-0.066	0.04	-0.25
NC0783	0.01	-0.043	0.04	-0.25
NC0784	0.00	-0.020	0.05	0.00
NC0785	0.01	-0.052	0.05	0.00
NC0787	0.00	-0.044	0.04	0.00
NC0800	-0.03	0.569	0.82	-0.25
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.05	-6.935	0.00	0.00
NC0860	-0.05	-6.823	0.00	0.00
NC0880	-0.05	-6.758	0.42	0.00
NC0882	-0.01	0.220	**1.22**	-0.25
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.294	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.173	0.00	0.00
NC0960	-0.01	0.185	0.06	0.00
NC0960_S1	-0.01	0.290	0.17	0.00
NC0960_S2	-0.02	0.327	0.07	0.00
NC0980	-0.01	0.290	0.00	0.00
NC1000	-0.02	0.300	0.00	0.00
NC1020	-0.02	0.288	**2.13**	-1.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.02	0.317	**10.78**	-0.25
NC1035	-0.02	0.296	0.00	0.00
NC1040	-0.02	0.350	**12.80**	-0.25
NC1050	-0.01	0.346	**13.70**	-0.25
NC1060	-0.02	0.327	-24.33	0.00
NC1060_E	-0.01	0.351	-24.16	0.00
NC1070	-0.02	0.443	-24.31	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.02	0.518	0.00	0.00
NC1200	-0.02	0.518	**31.30**	**1.25**
NC1210	-0.02	0.373	-24.34	0.00
NC1220	-0.01	0.162	0.00	0.00
NC1230	-0.01	0.095	0.00	0.00
NC1360	-0.01	0.044	-30.70	0.25
NC1362	0.00	0.069	-30.17	0.50
NC1380	0.00	0.175	0.00	0.00
NC1382	0.00	0.003	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.022	0.61	0.00
NH1060	0.00	0.006	0.61	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	-0.01	0.151	0.59	0.00
NH1082	-0.01	0.095	0.48	0.00
NH1084	-0.01	0.165	0.48	0.00
SterlingCanal	0.02	-1.461	**26.22**	0.00
SterlingCanal_East	0.03	-1.458	**19.91**	-1.50
SterlingCanal_N	0.14	-0.087	0.00	0.00
WabashDS	0.28	-1.681	**52.94**	-1.25
WabashUS	0.35	-1.392	**42.43**	-1.50
WoodallDS	0.17	-0.552	**72.50**	-0.75
WoodallUS	0.23	-0.715	**72.42**	-0.75

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.07	-1.162	0.32	0.00
BridgeBlvdDS	0.01	-1.548	**31.20**	-0.75
BridgeBlvdUS	0.01	-1.488	**27.03**	-1.00
BrunnellDS	0.00	-1.431	0.30	0.00
ChestnutDS	0.54	-0.484	**93.50**	-0.50
ChestnutUS	0.08	-0.551	**93.51**	-0.50
Downstream TW	0.00	0.000	-27.14	**1.75**
ExMHPWeir	------	------	------	------
GolfcartDS	0.34	-0.144	**67.38**	-0.25
GolfcartUS	0.54	-0.182	**71.27**	-0.25
HowardDS	0.53	-0.159	**74.87**	-0.25
HowardUS	0.62	-0.197	**84.44**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.35	-0.140	**67.34**	-0.25
Lake bonnet	-0.01	-0.012	-0.14	0.00
LakeBlanton_East	0.36	-0.151	**67.23**	-0.25
MayManorEast	0.03	-1.413	**5.32**	0.00
MayManorEast_2	0.02	-1.396	**5.27**	-2.75
MayManorHead	0.02	-1.398	**2.03**	-1.75
MayManorWest	0.03	-1.408	**15.96**	-0.25
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	0.000	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	0.02	-1.387	0.00	0.00
NC0260	0.02	-1.397	0.85	-0.25
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	0.000	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	-0.001	-0.01	0.00
NC0382	0.04	0.002	-0.02	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.23	-1.529	**53.03**	-1.25
NC0430	0.00	0.003	0.00	0.00
NC0440	0.00	-0.021	0.00	0.00
NC0442	0.00	-0.031	0.05	0.00
NC0460	0.20	-0.087	**94.90**	-0.50
NC0462	0.44	-0.042	**92.64**	-0.25
NC0480	0.56	-0.168	**67.05**	-0.25
NC0482	0.94	-1.056	**66.97**	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	-0.01	0.00
NC0540	-0.03	0.449	**61.54**	-4.00
NC0540_E1	-0.02	0.589	**67.39**	-0.25
NC0540_E2	-0.03	0.615	**145.42**	-5.00
NC0540_E3	-0.03	0.548	**75.47**	0.00
NC0540_E4	-0.03	0.647	**66.09**	-0.25
NC0540_E5	-0.02	0.654	**64.99**	-0.25
NC0560	-0.02	0.571	**1.31**	0.00
NC0570	-0.02	0.569	**50.26**	0.00
NC0572	-0.02	0.560	**67.04**	-0.25
NC0590	-0.01	0.329	**48.76**	-1.00
NC0620	-0.02	0.306	0.00	0.00
NC0630	-0.02	0.249	0.00	0.00
NC0631	-0.02	0.395	**49.03**	-1.00
NC0632	-0.01	0.275	**49.85**	-1.00
NC0635	-0.02	0.287	-20.53	0.00
NC0640	-0.02	0.272	-24.37	0.50
NC0650	-0.02	0.221	-24.08	0.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	**3.36**	0.00
NC0720	0.00	-0.003	0.00	0.00
NC0722	0.00	0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.003	0.00	0.00
NC0780	0.00	-0.003	0.00	0.00
NC0781	0.00	0.013	0.05	0.00
NC0782	0.01	-0.066	0.04	-0.25
NC0783	0.01	-0.043	0.04	-0.25
NC0784	0.00	-0.020	0.05	0.00
NC0785	0.01	-0.052	0.05	0.00
NC0787	0.00	-0.044	0.04	0.00
NC0800	-0.03	0.569	0.82	-0.25
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.05	-6.935	0.00	0.00
NC0860	-0.05	-6.823	0.00	0.00
NC0880	-0.05	-6.758	0.42	0.00
NC0882	-0.01	0.220	**1.22**	-0.25
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.294	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.173	0.00	0.00
NC0960	-0.01	0.185	0.06	0.00
NC0960_S1	-0.01	0.290	0.17	0.00
NC0960_S2	-0.02	0.327	0.07	0.00
NC0980	-0.01	0.290	0.00	0.00
NC1000	-0.02	0.300	0.00	0.00
NC1020	-0.02	0.288	**2.13**	-1.25

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 1 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.02	0.317	**10.78**	-0.25
NC1035	-0.02	0.296	0.00	0.00
NC1040	-0.02	0.350	**12.80**	-0.25
NC1050	-0.01	0.346	**13.70**	-0.25
NC1060	-0.02	0.327	-24.33	0.00
NC1060_E	-0.01	0.351	-24.16	0.00
NC1070	-0.02	0.443	-24.31	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.02	0.518	0.00	0.00
NC1200	-0.02	0.518	**31.30**	**1.25**
NC1210	-0.02	0.373	-24.34	0.00
NC1220	-0.01	0.162	0.00	0.00
NC1230	-0.01	0.095	0.00	0.00
NC1360	-0.01	0.044	-30.70	0.25
NC1362	0.00	0.069	-30.17	0.50
NC1380	0.00	0.175	0.00	0.00
NC1382	0.00	0.003	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.022	0.61	0.00
NH1060	0.00	0.006	0.61	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	-0.01	0.151	0.59	0.00
NH1082	-0.01	0.095	0.48	0.00
NH1084	-0.01	0.165	0.48	0.00
SterlingCanal	0.02	-1.461	**26.22**	0.00
SterlingCanal_East	0.03	-1.458	**19.91**	-1.50
SterlingCanal_N	0.14	-0.087	0.00	0.00
WabashDS	0.28	-1.681	**52.94**	-1.25
WabashUS	0.35	-1.392	**42.43**	-1.50
WoodallDS	0.17	-0.552	**72.50**	-0.75
WoodallUS	0.23	-0.715	**72.42**	-0.75

* Comparison of Existing vs Alt 1 Run 1, values are stage and flow differences

Positive values (red) are Alt 1 Run 1 Stage increase.

Positive values (green) are Alt 1 Run 1 Flow increase >1cfs.

APPENDIX C2

Existing Condition vs Alternative 2 Model Results

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.12	-1.042	0.29	0.00
BridgeBlvdDS	-0.04	-1.292	**28.87**	-0.75
BridgeBlvdUS	-0.04	-1.260	**23.16**	-1.00
BrunnellDS	-0.06	-1.244	0.29	0.00
ChestnutDS	0.45	-0.396	**77.75**	-0.25
ChestnutUS	0.07	-0.455	**77.29**	-0.50
Downstream TW	0.00	0.000	-20.08	0.50
ExMHPWeir	------	------	------	------
GolfcartDS	0.28	-0.086	**55.39**	-0.25
GolfcartUS	0.45	-0.109	**59.13**	-0.25
HowardDS	0.44	-0.095	**63.14**	-0.25
HowardUS	0.53	-0.134	**71.08**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.30	-0.100	**55.28**	0.00
Lake bonnet	-0.01	-0.011	-0.09	0.00
LakeBlanton_East	0.31	-0.097	**55.18**	-0.25
MayManorEast	-0.04	-1.227	**3.76**	-0.25
MayManorEast_2	-0.04	-1.212	**4.48**	-3.00
MayManorHead	-0.05	-1.223	**1.50**	-2.00
MayManorWest	-0.03	-1.223	**14.08**	-0.50
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.004	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.000	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	-0.05	-1.211	0.00	0.00
NC0260	-0.04	-1.223	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	0.003	-0.01	0.00
NC0382	0.03	0.003	-0.03	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.20	-1.385	**44.06**	-1.00
NC0430	0.00	0.002	0.00	0.00
NC0440	0.00	-0.019	0.00	0.00
NC0442	0.00	-0.023	0.06	0.00
NC0460	0.14	-0.055	**80.41**	-0.25
NC0462	0.36	-0.063	**77.88**	-0.25
NC0480	0.50	-0.104	**54.84**	-0.25
NC0482	0.88	-0.998	**54.88**	0.00
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	-0.02	0.456	**48.64**	-4.00
NC0540_E1	-0.02	0.544	**55.45**	0.00
NC0540_E2	-0.02	0.505	**290.52**	-5.00
NC0540_E3	-0.02	0.510	**48.39**	-1.00
NC0540_E4	-0.03	0.491	**55.53**	0.00
NC0540_E5	-0.02	0.522	**54.46**	0.00
NC0560	-0.02	0.497	**1.07**	0.00
NC0570	-0.02	0.502	**46.79**	0.00
NC0572	-0.01	0.392	**55.04**	0.00
NC0590	-0.01	0.341	**39.57**	-0.25
NC0620	-0.02	0.239	0.00	0.00
NC0630	-0.01	0.210	0.00	0.00
NC0631	-0.02	0.434	**39.49**	-0.25
NC0632	-0.01	0.206	**39.50**	-0.25
NC0635	-0.01	0.213	-18.19	-0.75
NC0640	-0.02	0.223	-21.83	0.00
NC0650	-0.01	0.130	-21.35	0.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 2 Model Results

2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	-20.66	-1.75
NC0720	0.00	-0.002	0.00	0.00
NC0722	0.00	-0.026	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.002	0.00	0.00
NC0780	0.00	-0.002	0.00	0.00
NC0781	0.00	0.044	0.04	0.00
NC0782	0.01	-0.054	0.03	-0.25
NC0783	0.01	-0.063	0.04	0.00
NC0784	0.00	-0.034	0.04	-0.25
NC0785	0.01	-0.035	0.04	0.00
NC0787	0.00	-0.036	0.03	0.00
NC0800	-0.02	0.462	0.63	-0.25
NC0820	0.00	-0.048	0.00	0.00
NC0840	0.00	-0.045	0.00	0.00
NC0860	0.00	-0.056	0.00	0.00
NC0880	0.00	-0.055	0.46	0.00
NC0882	-0.01	0.275	0.62	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.121	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.116	0.00	0.00
NC0960	-0.01	0.117	0.10	0.00
NC0960_S1	-0.01	0.123	0.08	0.00
NC0960_S2	-0.01	0.383	-0.12	0.00
NC0980	-0.01	0.122	0.00	0.00
NC1000	-0.01	0.223	0.00	0.00
NC1020	-0.01	0.269	-0.22	-1.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.01	0.372	**13.57**	-0.25
NC1035	-0.01	0.238	0.00	0.00
NC1040	-0.01	0.390	**15.98**	-0.25
NC1050	-0.01	0.388	**16.92**	-0.25
NC1060	-0.01	0.260	-21.09	0.25
NC1060_E	-0.01	0.294	-21.50	0.00
NC1070	-0.02	0.344	-21.15	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.01	0.327	0.00	0.00
NC1200	-0.01	0.327	-1.32	0.00
NC1210	-0.01	0.291	-21.15	0.00
NC1220	0.00	0.086	0.00	0.00
NC1230	-0.01	0.059	0.00	0.00
NC1360	-0.01	0.087	-20.92	0.00
NC1362	0.00	0.021	-20.36	0.00
NC1380	0.00	0.106	0.00	0.00
NC1382	0.00	0.017	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	0.000	0.49	0.00
NH1060	0.00	0.007	0.49	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.087	0.46	0.00
NH1082	-0.01	0.021	0.38	0.00
NH1084	-0.01	0.136	0.44	0.00
SterlingCanal	-0.04	-1.255	**21.64**	-0.75
SterlingCanal_East	-0.04	-1.277	**17.37**	-1.75
SterlingCanal_N	0.10	-0.090	0.00	0.00
WabashDS	0.23	-1.500	**43.96**	-1.00
WabashUS	0.29	-1.192	**35.94**	-1.50
WoodallDS	0.14	-0.429	**61.19**	-0.50
WoodallUS	0.20	-0.615	**60.95**	-0.75

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.12	-1.042	0.29	0.00
BridgeBlvdDS	-0.04	-1.292	**28.87**	-0.75
BridgeBlvdUS	-0.04	-1.260	**23.16**	-1.00
BrunnellDS	-0.06	-1.244	0.29	0.00
ChestnutDS	0.45	-0.396	**77.75**	-0.25
ChestnutUS	0.07	-0.455	**77.29**	-0.50
Downstream TW	0.00	0.000	-20.08	0.50
ExMHPWeir	------	------	------	------
GolfcartDS	0.28	-0.086	**55.39**	-0.25
GolfcartUS	0.45	-0.109	**59.13**	-0.25
HowardDS	0.44	-0.095	**63.14**	-0.25
HowardUS	0.53	-0.134	**71.08**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.30	-0.100	**55.28**	0.00
Lake bonnet	-0.01	-0.011	-0.09	0.00
LakeBlanton_East	0.31	-0.097	**55.18**	-0.25
MayManorEast	-0.04	-1.227	**3.76**	-0.25
MayManorEast_2	-0.04	-1.212	**4.48**	-3.00
MayManorHead	-0.05	-1.223	**1.50**	-2.00
MayManorWest	-0.03	-1.223	**14.08**	-0.50
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.004	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.000	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	-0.05	-1.211	0.00	0.00
NC0260	-0.04	-1.223	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	0.003	-0.01	0.00
NC0382	0.03	0.003	-0.03	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.20	-1.385	**44.06**	-1.00
NC0430	0.00	0.002	0.00	0.00
NC0440	0.00	-0.019	0.00	0.00
NC0442	0.00	-0.023	0.06	0.00
NC0460	0.14	-0.055	**80.41**	-0.25
NC0462	0.36	-0.063	**77.88**	-0.25
NC0480	0.50	-0.104	**54.84**	-0.25
NC0482	0.88	-0.998	**54.88**	0.00
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	-0.02	0.456	**48.64**	-4.00
NC0540_E1	-0.02	0.544	**55.45**	0.00
NC0540_E2	-0.02	0.505	**290.52**	-5.00
NC0540_E3	-0.02	0.510	**48.39**	-1.00
NC0540_E4	-0.03	0.491	**55.53**	0.00
NC0540_E5	-0.02	0.522	**54.46**	0.00
NC0560	-0.02	0.497	**1.07**	0.00
NC0570	-0.02	0.502	**46.79**	0.00
NC0572	-0.01	0.392	**55.04**	0.00
NC0590	-0.01	0.341	**39.57**	-0.25
NC0620	-0.02	0.239	0.00	0.00
NC0630	-0.01	0.210	0.00	0.00
NC0631	-0.02	0.434	**39.49**	-0.25
NC0632	-0.01	0.206	**39.50**	-0.25
NC0635	-0.01	0.213	-18.19	-0.75
NC0640	-0.02	0.223	-21.83	0.00
NC0650	-0.01	0.130	-21.35	0.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 2 Model Results

10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	-20.66	-1.75
NC0720	0.00	-0.002	0.00	0.00
NC0722	0.00	-0.026	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.002	0.00	0.00
NC0780	0.00	-0.002	0.00	0.00
NC0781	0.00	0.044	0.04	0.00
NC0782	0.01	-0.054	0.03	-0.25
NC0783	0.01	-0.063	0.04	0.00
NC0784	0.00	-0.034	0.04	-0.25
NC0785	0.01	-0.035	0.04	0.00
NC0787	0.00	-0.036	0.03	0.00
NC0800	-0.02	0.462	0.63	-0.25
NC0820	0.00	-0.048	0.00	0.00
NC0840	0.00	-0.045	0.00	0.00
NC0860	0.00	-0.056	0.00	0.00
NC0880	0.00	-0.055	0.46	0.00
NC0882	-0.01	0.275	0.62	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.121	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.116	0.00	0.00
NC0960	-0.01	0.117	0.10	0.00
NC0960_S1	-0.01	0.123	0.08	0.00
NC0960_S2	-0.01	0.383	-0.12	0.00
NC0980	-0.01	0.122	0.00	0.00
NC1000	-0.01	0.223	0.00	0.00
NC1020	-0.01	0.269	-0.22	-1.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.01	0.372	**13.57**	-0.25
NC1035	-0.01	0.238	0.00	0.00
NC1040	-0.01	0.390	**15.98**	-0.25
NC1050	-0.01	0.388	**16.92**	-0.25
NC1060	-0.01	0.260	-21.09	0.25
NC1060_E	-0.01	0.294	-21.50	0.00
NC1070	-0.02	0.344	-21.15	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.01	0.327	0.00	0.00
NC1200	-0.01	0.327	-1.32	0.00
NC1210	-0.01	0.291	-21.15	0.00
NC1220	0.00	0.086	0.00	0.00
NC1230	-0.01	0.059	0.00	0.00
NC1360	-0.01	0.087	-20.92	0.00
NC1362	0.00	0.021	-20.36	0.00
NC1380	0.00	0.106	0.00	0.00
NC1382	0.00	0.017	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	0.000	0.49	0.00
NH1060	0.00	0.007	0.49	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.087	0.46	0.00
NH1082	-0.01	0.021	0.38	0.00
NH1084	-0.01	0.136	0.44	0.00
SterlingCanal	-0.04	-1.255	**21.64**	-0.75
SterlingCanal_East	-0.04	-1.277	**17.37**	-1.75
SterlingCanal_N	0.10	-0.090	0.00	0.00
WabashDS	0.23	-1.500	**43.96**	-1.00
WabashUS	0.29	-1.192	**35.94**	-1.50
WoodallDS	0.14	-0.429	**61.19**	-0.50
WoodallUS	0.20	-0.615	**60.95**	-0.75

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.12	-1.042	0.29	0.00
BridgeBlvdDS	-0.04	-1.292	**28.87**	-0.75
BridgeBlvdUS	-0.04	-1.260	**23.16**	-1.00
BrunnellDS	-0.06	-1.244	0.29	0.00
ChestnutDS	0.45	-0.396	**77.75**	-0.25
ChestnutUS	0.07	-0.455	**77.29**	-0.50
Downstream TW	0.00	0.000	-20.08	0.50
ExMHPWeir	------	------	------	------
GolfcartDS	0.28	-0.086	**55.39**	-0.25
GolfcartUS	0.45	-0.109	**59.13**	-0.25
HowardDS	0.44	-0.095	**63.14**	-0.25
HowardUS	0.53	-0.134	**71.08**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.30	-0.100	**55.28**	0.00
Lake bonnet	-0.01	-0.011	-0.09	0.00
LakeBlanton_East	0.31	-0.097	**55.18**	-0.25
MayManorEast	-0.04	-1.227	**3.76**	-0.25
MayManorEast_2	-0.04	-1.212	**4.48**	-3.00
MayManorHead	-0.05	-1.223	**1.50**	-2.00
MayManorWest	-0.03	-1.223	**14.08**	-0.50
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.004	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.000	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	-0.05	-1.211	0.00	0.00
NC0260	-0.04	-1.223	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	0.003	-0.01	0.00
NC0382	0.03	0.003	-0.03	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.20	-1.385	**44.06**	-1.00
NC0430	0.00	0.002	0.00	0.00
NC0440	0.00	-0.019	0.00	0.00
NC0442	0.00	-0.023	0.06	0.00
NC0460	0.14	-0.055	**80.41**	-0.25
NC0462	0.36	-0.063	**77.88**	-0.25
NC0480	0.50	-0.104	**54.84**	-0.25
NC0482	0.88	-0.998	**54.88**	0.00
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	-0.02	0.456	**48.64**	-4.00
NC0540_E1	-0.02	0.544	**55.45**	0.00
NC0540_E2	-0.02	0.505	**290.52**	-5.00
NC0540_E3	-0.02	0.510	**48.39**	-1.00
NC0540_E4	-0.03	0.491	**55.53**	0.00
NC0540_E5	-0.02	0.522	**54.46**	0.00
NC0560	-0.02	0.497	**1.07**	0.00
NC0570	-0.02	0.502	**46.79**	0.00
NC0572	-0.01	0.392	**55.04**	0.00
NC0590	-0.01	0.341	**39.57**	-0.25
NC0620	-0.02	0.239	0.00	0.00
NC0630	-0.01	0.210	0.00	0.00
NC0631	-0.02	0.434	**39.49**	-0.25
NC0632	-0.01	0.206	**39.50**	-0.25
NC0635	-0.01	0.213	-18.19	-0.75
NC0640	-0.02	0.223	-21.83	0.00
NC0650	-0.01	0.130	-21.35	0.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	-20.66	-1.75
NC0720	0.00	-0.002	0.00	0.00
NC0722	0.00	-0.026	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.002	0.00	0.00
NC0780	0.00	-0.002	0.00	0.00
NC0781	0.00	0.044	0.04	0.00
NC0782	0.01	-0.054	0.03	-0.25
NC0783	0.01	-0.063	0.04	0.00
NC0784	0.00	-0.034	0.04	-0.25
NC0785	0.01	-0.035	0.04	0.00
NC0787	0.00	-0.036	0.03	0.00
NC0800	-0.02	0.462	0.63	-0.25
NC0820	0.00	-0.048	0.00	0.00
NC0840	0.00	-0.045	0.00	0.00
NC0860	0.00	-0.056	0.00	0.00
NC0880	0.00	-0.055	0.46	0.00
NC0882	-0.01	0.275	0.62	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.121	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.116	0.00	0.00
NC0960	-0.01	0.117	0.10	0.00
NC0960_S1	-0.01	0.123	0.08	0.00
NC0960_S2	-0.01	0.383	-0.12	0.00
NC0980	-0.01	0.122	0.00	0.00
NC1000	-0.01	0.223	0.00	0.00
NC1020	-0.01	0.269	-0.22	-1.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.01	0.372	**13.57**	-0.25
NC1035	-0.01	0.238	0.00	0.00
NC1040	-0.01	0.390	**15.98**	-0.25
NC1050	-0.01	0.388	**16.92**	-0.25
NC1060	-0.01	0.260	-21.09	0.25
NC1060_E	-0.01	0.294	-21.50	0.00
NC1070	-0.02	0.344	-21.15	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.01	0.327	0.00	0.00
NC1200	-0.01	0.327	-1.32	0.00
NC1210	-0.01	0.291	-21.15	0.00
NC1220	0.00	0.086	0.00	0.00
NC1230	-0.01	0.059	0.00	0.00
NC1360	-0.01	0.087	-20.92	0.00
NC1362	0.00	0.021	-20.36	0.00
NC1380	0.00	0.106	0.00	0.00
NC1382	0.00	0.017	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	0.000	0.49	0.00
NH1060	0.00	0.007	0.49	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.087	0.46	0.00
NH1082	-0.01	0.021	0.38	0.00
NH1084	-0.01	0.136	0.44	0.00
SterlingCanal	-0.04	-1.255	**21.64**	-0.75
SterlingCanal_East	-0.04	-1.277	**17.37**	-1.75
SterlingCanal_N	0.10	-0.090	0.00	0.00
WabashDS	0.23	-1.500	**43.96**	-1.00
WabashUS	0.29	-1.192	**35.94**	-1.50
WoodallDS	0.14	-0.429	**61.19**	-0.50
WoodallUS	0.20	-0.615	**60.95**	-0.75

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
BonnetControl	-0.12	-1.042	0.29	0.00
BridgeBlvdDS	-0.04	-1.292	**28.87**	-0.75
BridgeBlvdUS	-0.04	-1.260	**23.16**	-1.00
BrunnellDS	-0.06	-1.244	0.29	0.00
ChestnutDS	0.45	-0.396	**77.75**	-0.25
ChestnutUS	0.07	-0.455	**77.29**	-0.50
Downstream TW	0.00	0.000	-20.08	0.50
ExMHPWeir	------	------	------	------
GolfcartDS	0.28	-0.086	**55.39**	-0.25
GolfcartUS	0.45	-0.109	**59.13**	-0.25
HowardDS	0.44	-0.095	**63.14**	-0.25
HowardUS	0.53	-0.134	**71.08**	-0.25
LAGOON	0.00	-0.012	0.00	0.00
Lake Blanton_West	0.30	-0.100	**55.28**	0.00
Lake bonnet	-0.01	-0.011	-0.09	0.00
LakeBlanton_East	0.31	-0.097	**55.18**	-0.25
MayManorEast	-0.04	-1.227	**3.76**	-0.25
MayManorEast_2	-0.04	-1.212	**4.48**	-3.00
MayManorHead	-0.05	-1.223	**1.50**	-2.00
MayManorWest	-0.03	-1.223	**14.08**	-0.50
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.004	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.000	0.00	0.00
NC0120Sd	0.00	0.001	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00
NC0200	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0240	-0.05	-1.211	0.00	0.00
NC0260	-0.04	-1.223	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.01	0.003	-0.01	0.00
NC0382	0.03	0.003	-0.03	0.00
NC0390	0.00	-0.003	0.00	0.00
NC0398	0.20	-1.385	**44.06**	-1.00
NC0430	0.00	0.002	0.00	0.00
NC0440	0.00	-0.019	0.00	0.00
NC0442	0.00	-0.023	0.06	0.00
NC0460	0.14	-0.055	**80.41**	-0.25
NC0462	0.36	-0.063	**77.88**	-0.25
NC0480	0.50	-0.104	**54.84**	-0.25
NC0482	0.88	-0.998	**54.88**	0.00
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	-0.02	0.456	**48.64**	-4.00
NC0540_E1	-0.02	0.544	**55.45**	0.00
NC0540_E2	-0.02	0.505	**290.52**	-5.00
NC0540_E3	-0.02	0.510	**48.39**	-1.00
NC0540_E4	-0.03	0.491	**55.53**	0.00
NC0540_E5	-0.02	0.522	**54.46**	0.00
NC0560	-0.02	0.497	**1.07**	0.00
NC0570	-0.02	0.502	**46.79**	0.00
NC0572	-0.01	0.392	**55.04**	0.00
NC0590	-0.01	0.341	**39.57**	-0.25
NC0620	-0.02	0.239	0.00	0.00
NC0630	-0.01	0.210	0.00	0.00
NC0631	-0.02	0.434	**39.49**	-0.25
NC0632	-0.01	0.206	**39.50**	-0.25
NC0635	-0.01	0.213	-18.19	-0.75
NC0640	-0.02	0.223	-21.83	0.00
NC0650	-0.01	0.130	-21.35	0.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 2 Model Results

100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.01	-0.003	-20.66	-1.75
NC0720	0.00	-0.002	0.00	0.00
NC0722	0.00	-0.026	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.002	0.00	0.00
NC0780	0.00	-0.002	0.00	0.00
NC0781	0.00	0.044	0.04	0.00
NC0782	0.01	-0.054	0.03	-0.25
NC0783	0.01	-0.063	0.04	0.00
NC0784	0.00	-0.034	0.04	-0.25
NC0785	0.01	-0.035	0.04	0.00
NC0787	0.00	-0.036	0.03	0.00
NC0800	-0.02	0.462	0.63	-0.25
NC0820	0.00	-0.048	0.00	0.00
NC0840	0.00	-0.045	0.00	0.00
NC0860	0.00	-0.056	0.00	0.00
NC0880	0.00	-0.055	0.46	0.00
NC0882	-0.01	0.275	0.62	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	-0.01	0.121	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	-0.01	0.116	0.00	0.00
NC0960	-0.01	0.117	0.10	0.00
NC0960_S1	-0.01	0.123	0.08	0.00
NC0960_S2	-0.01	0.383	-0.12	0.00
NC0980	-0.01	0.122	0.00	0.00
NC1000	-0.01	0.223	0.00	0.00
NC1020	-0.01	0.269	-0.22	-1.25

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 2 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	Time to Max Inflow Rate [hrs]
NC1030	-0.01	0.372	**13.57**	-0.25
NC1035	-0.01	0.238	0.00	0.00
NC1040	-0.01	0.390	**15.98**	-0.25
NC1050	-0.01	0.388	**16.92**	-0.25
NC1060	-0.01	0.260	-21.09	0.25
NC1060_E	-0.01	0.294	-21.50	0.00
NC1070	-0.02	0.344	-21.15	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	-0.01	0.327	0.00	0.00
NC1200	-0.01	0.327	-1.32	0.00
NC1210	-0.01	0.291	-21.15	0.00
NC1220	0.00	0.086	0.00	0.00
NC1230	-0.01	0.059	0.00	0.00
NC1360	-0.01	0.087	-20.92	0.00
NC1362	0.00	0.021	-20.36	0.00
NC1380	0.00	0.106	0.00	0.00
NC1382	0.00	0.017	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	0.000	0.49	0.00
NH1060	0.00	0.007	0.49	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.087	0.46	0.00
NH1082	-0.01	0.021	0.38	0.00
NH1084	-0.01	0.136	0.44	0.00
SterlingCanal	-0.04	-1.255	**21.64**	-0.75
SterlingCanal_East	-0.04	-1.277	**17.37**	-1.75
SterlingCanal_N	0.10	-0.090	0.00	0.00
WabashDS	0.23	-1.500	**43.96**	-1.00
WabashUS	0.29	-1.192	**35.94**	-1.50
WoodallDS	0.14	-0.429	**61.19**	-0.50
WoodallUS	0.20	-0.615	**60.95**	-0.75

* Comparison of Existing vs Alt 2 Run 1, values are stage and flow differences

Positive values (red) are Alt 2 Run 1 Stage increase.

Positive values (green) are Alt 2 Run 1 Flow increase >1cfs.

APPENDIX C3

Existing Condition vs Alternative 3 Model Results

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-0.56	0.35	-14.29	**3.00**
BridgeBlvdDS	-0.47	0.64	**4.78**	-3.00
BridgeBlvdUS	-0.54	0.42	**25.04**	0.25
BrunnellDS	-0.58	0.43	-14.29	**3.00**
ChestnutDS	-0.82	1.43	-59.43	**1.50**
ChestnutUS	-0.12	1.42	-59.11	**1.25**
Downstream TW	0.00	0.00	-39.21	**18.25**
GolfcartDS	-0.65	1.43	-67.68	**1.50**
GolfcartUS	-0.72	1.45	-67.86	**1.50**
HowardDS	-0.74	1.43	-66.24	**1.25**
HowardUS	-0.78	1.40	-66.19	**1.50**
LAGOON	-0.44	-11.36	0.00	0.00
Lake Blanton_West	-0.60	1.46	-67.19	**1.25**
Lake bonnet	-0.63	4.33	-0.66	0.00
LakeBlanton_East	-0.59	1.43	-67.57	**1.50**
MayManorEast	-0.56	0.40	**31.51**	-4.25
MayManorEast_2	-0.56	0.39	**31.42**	-4.25
MayManorEast_3				
MayManorHead	-0.57	0.40	-1.35	-1.75
MayManorWest	-0.55	0.45	**19.88**	-4.75
MHPWEIRDS				
MHPWeirUS				
NC0020	0.00	-0.02	0.00	0.00
NC0040	0.00	0.00	0.00	0.00
NC0060	0.00	0.01	0.02	0.00
NC0080	0.00	0.00	0.00	0.00
NC0090	0.00	0.01	0.00	0.00
NC0100	0.00	0.00	0.00	0.00
NC0120S	0.00	0.01	0.00	0.00
NC0120Sa	0.00	0.00	0.00	0.00
NC0120Sb	0.00	0.00	0.00	0.00
NC0120Sc	0.00	0.00	0.00	0.00
NC0120Sd	0.00	-0.01	0.00	0.00
NC0140	0.00	0.00	-0.03	0.00
NC0160	0.00	0.00	0.04	0.00
NC0180	0.00	0.00	0.01	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	-0.01	0.03	-0.03	0.00
NC0240	0.02	-0.07	0.00	0.00
NC0260	-0.40	-1.26	-0.01	0.00
NC0300	0.00	0.01	0.00	0.00
NC0360	0.00	0.00	0.00	0.00
NC0365	0.00	0.00	0.00	0.00
NC0370	0.00	0.00	0.03	0.00
NC0380	0.00	0.00	0.06	0.00
NC0382	0.33	0.04	0.05	0.00
NC0390	0.02	0.06	0.00	0.00
NC0398	-0.30	1.18	-48.81	0.75
NC0430	0.00	0.00	0.00	0.00
NC0440	0.00	0.01	0.00	0.00
NC0442	0.00	0.00	0.00	0.00
NC0460	-0.84	1.44	-67.44	**1.50**
NC0462	-0.63	1.38	-66.28	**1.50**
NC0480	-0.40	1.43	-67.70	**1.50**
NC0482	-0.75	1.51	-67.69	**1.50**
NC0500	0.00	0.00	0.00	0.00
NC0510	0.00	0.00	-0.24	0.00
NC0520	0.00	0.00	0.07	0.00
NC0540	-0.20	13.75	-55.86	1.00
NC0540_E1	-0.20	13.57	-67.57	**1.50**
NC0540_E2	-0.20	13.62	-214.22	0.75
NC0540_E3	-0.20	13.64	-77.67	0.25
NC0540_E4	-0.20	13.64	-56.48	1.00
NC0540_E5	-0.20	13.57	-55.31	1.00
NC0560	-0.01	-24.41	-1.56	1.00
NC0570	-0.14	5.41	-1.41	0.25
NC0572	-0.36	-0.90	-67.70	**1.50**
NC0590	-0.13	12.75	-49.80	0.75
NC0620	0.00	0.00	0.00	0.00
NC0630	0.00	0.00	-0.26	0.00
NC0631	-0.12	12.82	-49.60	0.75
NC0632	-0.12	12.47	-49.36	0.75
NC0635	-0.12	3.04	-48.65	0.50

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	-0.11	2.61	-47.61	0.25
NC0650	-0.10	2.87	-46.73	0.25
NC0660	0.00	0.01	-0.04	0.00
NC0670	0.00	0.00	-0.05	0.00
NC0680	0.00	0.00	0.00	0.00
NC0700	0.00	0.01	-0.01	0.00
NC0720	0.00	0.00	0.04	0.00
NC0722	0.00	-0.01	0.01	0.00
NC0740	0.00	0.00	0.00	0.00
NC0760	0.00	0.00	-0.02	0.00
NC0780	0.00	0.00	0.01	0.00
NC0781	0.00	0.01	0.01	0.00
NC0782	0.00	0.01	0.01	0.00
NC0783	0.00	0.00	0.01	0.00
NC0784	0.00	-0.01	0.01	0.00
NC0785	0.00	0.03	0.01	0.00
NC0787	0.00	0.01	0.03	0.00
NC0800	0.00	0.00	-0.02	0.00
NC0820	-0.04	-0.58	0.00	0.00
NC0840	-0.04	-0.18	0.00	0.00
NC0860	-0.04	-0.24	-0.04	0.00
NC0880	-0.04	-0.31	-1.26	0.00
NC0882	-0.09	2.50	-1.61	0.50
NC0900	0.00	0.00	-0.02	0.00
NC0912	0.00	0.00	0.03	0.00
NC0920	0.00	0.00	-0.18	0.00
NC0925	0.00	0.00	0.03	0.00
NC0930	0.00	0.00	0.00	0.00
NC0935	0.00	0.00	0.12	0.00
NC0937	0.00	0.00	0.00	0.00
NC0940	0.00	0.00	0.00	0.00
NC0950	0.00	0.00	-0.02	0.00
NC0955	0.00	0.00	-0.12	0.00
NC0960	0.00	0.00	-0.02	0.00
NC0960_S1	-0.10	2.25	0.00	0.00
NC0960_S2	-0.10	2.28	-0.01	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	0.00	0.00	0.00	0.00
NC1000	0.00	0.01	0.01	0.00
NC1020	-0.10	2.43	0.02	0.00
NC1030	-0.10	2.50	-3.85	-2.00
NC1035	0.00	0.00	-0.07	0.00
NC1040	-0.09	2.49	-8.05	-2.00
NC1050	-0.09	2.71	-17.87	-1.75
NC1060	-0.08	2.31	-43.37	0.00
NC1060_E	-0.10	2.73	-46.26	0.50
NC1070	-0.07	1.90	-43.34	0.00
NC1180	0.00	0.01	0.00	0.00
NC1190	-0.07	1.88	0.00	0.00
NC1200	-0.07	1.88	-3.96	**5.00**
NC1210	-0.07	1.95	-43.29	0.00
NC1220	-0.04	0.80	0.02	0.00
NC1230	-0.04	0.84	-0.02	0.00
NC1360	-0.04	0.72	-43.61	-0.25
NC1362	0.00	0.56	-43.93	-0.25
NC1380	0.00	0.00	0.00	0.00
NC1382	0.00	0.00	0.00	0.00
NH1042	0.00	0.00	0.00	0.00
NH1044	0.00	-0.01	0.77	0.00
NH1060	-0.01	-0.02	0.77	0.00
NH1060_SA	0.00	0.00	0.08	0.00
NH1080	-0.12	12.99	0.76	0.00
NH1082	-0.12	12.97	0.81	0.00
NH1084	-0.11	12.90	0.76	0.00
SterlingCanal	-0.55	0.35	**26.48**	0.25
SterlingCanal_East	-0.55	0.41	**29.77**	0.25
SterlingCanal_N	0.00	0.03	0.00	0.00
Sump				
WabashDS	-0.34	1.15	-48.82	0.75
WabashUS	-0.35	1.10	-47.36	0.25
WoodallDS	-0.16	1.34	-52.59	**1.25**
WoodallUS	-0.26	1.25	-52.55	**1.25**

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-1.09	-0.75	-25.16	2.00
BridgeBlvdDS	-0.93	-0.21	-3.93	-3.25
BridgeBlvdUS	-1.01	-0.50	**35.30**	-3.75
BrunnellDS	-1.07	-0.59	-25.16	2.00
ChestnutDS	-1.18	0.40	-101.89	0.50
ChestnutUS	-0.15	0.40	-102.47	0.50
Downstream TW	0.00	0.00	-71.87	0.75
GolfcartDS	-0.71	0.13	-101.42	0.25
GolfcartUS	-0.84	0.13	-103.14	0.25
HowardDS	-0.80	0.15	-105.91	0.50
HowardUS	-0.86	0.20	-106.16	0.50
LAGOON	-0.41	2.01	-0.02	0.00
Lake Blanton_West	-0.66	0.12	-101.51	0.00
Lake bonnet	-0.41	2.05	-0.45	0.00
LakeBlanton_East	-0.65	0.13	-101.21	0.25
MayManorEast	-1.04	-0.46	**41.63**	-6.50
MayManorEast_2	-1.04	-0.48	**46.84**	-7.25
MayManorEast_3				
MayManorHead	-1.06	-0.52	-19.61	-2.75
MayManorWest	-1.02	-0.45	**27.10**	-5.50
MHPWEIRDS				
MHPWeirUS				
NC0020	0.00	0.00	0.00	0.00
NC0040	0.00	0.01	0.00	0.00
NC0060	0.00	0.00	0.03	0.00
NC0080	0.00	0.00	-0.01	0.00
NC0090	0.00	0.00	0.00	0.00
NC0100	0.00	0.00	0.00	0.00
NC0120S	0.00	0.01	0.02	0.00
NC0120Sa	0.00	0.00	0.00	0.00
NC0120Sb	0.00	0.00	0.00	0.00
NC0120Sc	0.00	0.00	0.01	0.00
NC0120Sd	0.00	0.00	0.00	0.00
NC0140	0.00	0.00	-0.03	0.00
NC0160	0.00	0.00	0.06	0.00
NC0180	0.00	0.00	0.01	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	-0.06	0.01	-0.05	0.00
NC0240	-0.05	0.07	0.00	0.00
NC0260	-0.41	-0.24	-0.01	0.00
NC0300	0.00	0.00	0.01	0.00
NC0360	0.00	0.00	0.00	0.00
NC0365	0.00	0.01	0.00	0.00
NC0370	0.00	0.00	0.05	0.00
NC0380	0.06	-0.03	0.10	0.00
NC0382	0.11	-0.03	0.10	0.00
NC0390	0.02	0.01	0.00	0.00
NC0398	-0.62	0.64	-94.81	0.00
NC0430	0.00	0.00	0.01	0.00
NC0440	0.00	0.00	-0.01	0.00
NC0442	0.00	0.02	0.00	0.00
NC0460	-1.01	0.42	-106.88	0.50
NC0462	-0.85	0.31	-106.41	0.25
NC0480	-0.49	0.13	-101.69	0.00
NC0482	-0.85	0.14	-101.73	0.00
NC0500	0.00	0.00	0.00	0.00
NC0510	0.00	0.00	-0.35	0.00
NC0520	0.00	0.00	0.18	0.00
NC0540	-0.25	0.97	-99.06	-0.50
NC0540_E1	-0.26	1.53	-101.66	0.00
NC0540_E2	-0.26	1.53	-331.56	-0.25
NC0540_E3	-0.26	1.40	-94.61	0.00
NC0540_E4	-0.25	1.47	-100.87	-0.25
NC0540_E5	-0.25	1.48	-101.82	-0.50
NC0560	-0.26	1.26	-2.39	0.50
NC0570	-0.25	1.15	-41.02	0.00
NC0572	-0.27	1.53	-101.79	0.00
NC0590	-0.21	0.95	-84.56	0.25
NC0620	0.00	0.00	0.00	0.00
NC0630	0.00	0.00	-0.34	0.00
NC0631	-0.21	0.96	-84.37	0.25
NC0632	-0.21	1.04	-83.61	0.50
NC0635	-0.21	1.03	-76.71	0.50

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	-0.20	0.96	-80.51	-2.00
NC0650	-0.16	1.20	-83.72	-1.75
NC0660	0.00	0.00	-0.04	0.00
NC0670	0.00	0.00	0.06	0.00
NC0680	0.00	0.00	-0.01	0.00
NC0700	0.00	-0.01	0.00	0.00
NC0720	0.00	0.01	0.04	0.00
NC0722	0.00	0.04	0.00	0.00
NC0740	0.00	0.00	0.00	0.00
NC0760	0.00	0.00	0.00	0.00
NC0780	0.00	0.00	0.06	0.00
NC0781	0.00	0.01	0.00	0.00
NC0782	0.00	0.01	-0.01	0.00
NC0783	0.00	0.00	0.00	0.00
NC0784	0.00	0.00	0.00	0.00
NC0785	0.00	0.01	0.00	0.00
NC0787	0.00	0.00	0.07	0.00
NC0800	-0.24	1.20	0.01	0.00
NC0820	-0.07	-4.49	-0.01	0.00
NC0840	-0.07	-3.40	0.00	0.00
NC0860	-0.06	-3.16	-0.06	0.00
NC0880	-0.06	-3.07	-1.00	0.00
NC0882	-0.16	1.00	-2.34	0.50
NC0900	0.00	0.00	-0.02	0.00
NC0912	0.00	0.00	-0.07	0.00
NC0920	0.00	0.00	**1.38**	0.00
NC0925	0.00	0.00	0.03	0.00
NC0930	0.00	0.00	0.00	0.00
NC0935	0.00	0.00	0.00	0.00
NC0937	0.00	0.01	0.00	0.00
NC0940	0.00	0.00	-0.01	0.00
NC0950	0.00	0.00	-0.03	0.00
NC0955	0.00	0.00	-0.04	0.00
NC0960	-0.16	0.97	-0.01	0.00
NC0960_S1	-0.15	0.98	0.20	0.00
NC0960_S2	-0.15	0.87	**2.26**	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	-0.15	0.91	0.00	0.00
NC1000	-0.15	0.94	0.03	0.00
NC1020	-0.15	1.02	-0.06	0.00
NC1030	-0.15	1.00	0.11	0.00
NC1035	-0.16	0.99	-0.10	0.00
NC1040	-0.16	1.05	0.08	0.00
NC1050	-0.15	0.98	-7.59	-1.00
NC1060	-0.15	1.03	-82.12	-1.50
NC1060_E	-0.15	0.97	-84.75	-1.50
NC1070	-0.11	0.81	-81.84	-1.50
NC1180	0.00	0.00	0.00	0.00
NC1190	-0.09	0.91	0.00	0.00
NC1200	-0.09	0.91	-1.24	2.00
NC1210	-0.09	0.75	-82.01	-1.50
NC1220	-0.05	0.45	0.04	0.00
NC1230	-0.05	0.46	0.03	0.00
NC1360	-0.05	0.49	-93.84	-0.75
NC1362	0.00	0.02	-91.44	16.25
NC1380	0.00	0.00	0.00	0.00
NC1382	0.00	0.00	0.00	0.00
NH1042	0.00	0.00	0.00	0.00
NH1044	0.00	0.00	**1.05**	0.00
NH1060	-0.02	0.00	**1.06**	0.00
NH1060_SA	0.00	0.00	0.12	0.00
NH1080	-0.19	0.26	**1.07**	0.00
NH1082	-0.20	0.28	0.92	0.00
NH1084	-0.21	0.80	0.85	0.00
SterlingCanal	-1.02	-0.47	**77.61**	0.25
SterlingCanal_East	-1.02	-0.46	**72.53**	-5.00
SterlingCanal_N	-0.03	-0.08	0.01	0.00
Sump				
WabashDS	-0.67	0.66	-94.81	0.00
WabashUS	-0.73	0.00	-95.79	-0.25
WoodallDS	-0.25	0.38	-95.53	0.25
WoodallUS	-0.56	0.60	-96.43	0.75

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-1.11	9.87	-27.31	**1.00**
BridgeBlvdDS	-1.01	-0.58	-34.51	-4.00
BridgeBlvdUS	-1.04	-0.46	**17.09**	-4.75
BrunnellDS	-1.10	-0.59	-27.31	**1.00**
ChestnutDS	-1.01	0.48	-106.63	0.50
ChestnutUS	-0.14	0.47	-106.57	0.50
Downstream TW	0.00	0.00	-104.91	**1.50**
GolfcartDS	-0.62	-0.15	-102.80	-0.25
GolfcartUS	-0.76	-0.15	-104.30	0.00
HowardDS	-0.69	-0.15	-109.12	0.25
HowardUS	-0.75	-0.08	-109.85	0.25
LAGOON	-0.38	1.19	0.01	0.00
Lake Blanton_West	-0.57	-0.15	-102.51	0.00
Lake bonnet	-0.37	1.20	-5.10	0.00
LakeBlanton_East	-0.57	-0.15	-102.87	0.00
MayManorEast	-1.07	-0.50	**26.24**	-9.25
MayManorEast_2	-1.07	-0.47	**28.46**	-7.75
MayManorEast_3				
MayManorHead	-1.10	-0.51	-30.23	-1.00
MayManorWest	-1.05	-0.46	**3.56**	-5.50
NC0020	0.00	-0.02	0.01	0.00
NC0040	0.00	0.00	-0.01	0.00
NC0060	0.00	0.00	0.04	0.00
NC0080	0.00	0.01	0.00	0.00
NC0090	0.00	0.00	0.00	0.00
NC0100	0.00	0.00	0.00	0.00
NC0120S	0.00	0.01	0.03	0.00
NC0120Sa	0.00	0.00	0.00	0.00
NC0120Sb	0.00	0.00	0.00	0.00
NC0120Sc	0.00	0.00	0.01	0.00
NC0120Sd	0.00	0.00	0.02	0.00
NC0140	0.00	0.00	-0.05	0.00
NC0160	0.00	0.00	0.07	0.00
NC0180	0.00	0.00	0.01	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.02	-0.05	0.00
NC0240	-0.07	-0.06	0.00	0.00
NC0260	-0.12	0.67	-0.01	0.00
NC0300	0.00	0.00	0.00	0.00
NC0360	0.00	0.00	-0.01	0.00
NC0365	0.00	0.00	0.00	0.00
NC0370	0.00	0.00	0.06	0.00
NC0380	0.02	-0.02	0.12	0.00
NC0382	0.05	-0.07	0.28	0.00
NC0390	0.03	-0.03	0.01	0.00
NC0398	-0.62	0.10	-104.55	-0.25
NC0430	0.00	0.00	0.00	0.00
NC0440	0.00	0.00	0.01	0.00
NC0442	0.00	0.00	0.01	0.25
NC0460	-0.89	0.17	-111.15	0.25
NC0462	-0.74	0.03	-110.64	0.25
NC0480	-0.45	-0.14	-102.34	0.00
NC0482	-0.75	-0.06	-102.29	0.00
NC0500	0.00	0.00	-0.01	0.00
NC0510	0.00	0.00	-0.41	0.00
NC0520	0.00	0.00	-0.44	0.00
NC0540	-0.24	1.10	-110.30	0.00
NC0540_E1	-0.25	1.10	-102.79	-0.25
NC0540_E2	-0.25	1.21	-363.95	-0.25
NC0540_E3	-0.25	1.08	-122.72	0.25
NC0540_E4	-0.24	1.16	-109.49	-0.25
NC0540_E5	-0.24	1.23	-110.09	0.00
NC0560	-0.25	1.46	-1.64	0.00
NC0570	-0.23	1.17	-49.66	0.50
NC0572	-0.25	1.26	-102.33	-0.25
NC0590	-0.19	0.95	-99.58	-3.25
NC0620	0.00	0.00	0.00	0.00
NC0630	0.00	0.00	-0.42	0.00
NC0631	-0.19	0.93	-100.12	-3.50
NC0632	-0.18	0.90	-100.77	-1.00
NC0635	-0.18	0.84	-91.14	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	-0.18	0.87	-101.81	0.75
NC0650	-0.21	1.07	-102.11	0.75
NC0660	0.00	0.00	-0.04	0.00
NC0670	0.00	0.00	-0.07	0.00
NC0680	0.00	0.00	-0.01	0.00
NC0700	-0.04	-0.42	-0.01	0.00
NC0720	-0.03	-0.22	0.01	0.00
NC0722	-0.03	-0.19	-0.01	0.00
NC0740	0.00	0.00	0.00	0.00
NC0760	0.00	0.00	0.02	0.00
NC0780	0.00	0.00	-0.04	0.00
NC0781	0.00	0.00	**1.04**	-1.00
NC0782	0.00	0.00	**1.04**	-1.00
NC0783	0.00	0.00	**1.04**	-1.00
NC0784	0.00	0.01	**1.05**	-0.75
NC0785	0.00	0.00	**1.05**	-0.50
NC0787	0.00	0.00	-0.20	0.00
NC0800	-0.24	1.17	0.00	0.00
NC0820	-0.10	-7.10	0.00	0.00
NC0840	-0.08	-6.06	0.00	0.00
NC0860	-0.08	-5.93	-0.07	0.00
NC0880	-0.08	-5.84	-0.68	0.00
NC0882	-0.21	1.11	-1.93	0.25
NC0900	0.00	0.00	-0.02	0.00
NC0912	0.00	0.00	-0.08	0.00
NC0920	0.00	0.00	-0.03	0.00
NC0925	0.00	0.00	0.04	0.00
NC0930	0.00	0.00	0.00	0.00
NC0935	0.00	0.00	0.01	0.00
NC0937	0.00	0.01	0.01	0.00
NC0940	0.00	0.00	-0.01	0.00
NC0950	0.00	0.01	-0.03	0.00
NC0955	-0.01	-24.35	-0.04	0.00
NC0960	-0.21	1.12	-0.01	0.00
NC0960_S1	-0.20	1.10	0.35	0.00
NC0960_S2	-0.20	0.96	**1.63**	-0.25

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	-0.20	1.10	0.00	0.00
NC1000	-0.20	1.08	0.04	0.00
NC1020	-0.20	1.09	**1.38**	0.75
NC1030	-0.20	1.11	-0.50	**17.75**
NC1035	-0.21	1.09	-0.12	0.00
NC1040	-0.21	1.09	0.16	**20.00**
NC1050	-0.21	1.02	-6.23	-1.25
NC1060	-0.20	1.06	-103.03	0.75
NC1060_E	-0.20	0.99	-102.19	0.75
NC1070	-0.12	0.92	-102.81	**1.00**
NC1180	0.00	0.00	0.00	0.00
NC1190	-0.10	0.78	0.00	0.00
NC1200	-0.10	0.78	**8.36**	**1.75**
NC1210	-0.10	0.68	-102.75	**1.00**
NC1220	-0.06	0.49	0.06	0.00
NC1230	-0.06	0.48	-0.02	0.00
NC1360	-0.06	0.42	-107.24	**1.25**
NC1362	0.00	-0.14	-106.03	**1.25**
NC1380	0.00	-0.02	0.00	0.00
NC1382	0.00	0.00	0.00	0.00
NH1042	0.00	0.00	0.00	0.00
NH1044	0.00	0.00	**4.90**	0.00
NH1060	-0.03	0.02	**4.90**	0.00
NH1060_SA	0.00	0.00	0.15	0.00
NH1080	-0.17	0.45	**4.81**	0.00
NH1082	-0.19	0.45	**4.51**	0.00
NH1084	-0.18	0.83	**4.38**	0.00
SterlingCanal	-1.04	-0.46	**81.87**	-3.00
SterlingCanal_East	-1.05	-0.46	**59.16**	-5.25
SterlingCanal_N	-0.05	-0.12	0.00	0.00
WabashDS	-0.68	0.10	-104.58	-0.25
WabashUS	-0.77	0.10	-107.05	-0.50
WoodallDS	-0.26	0.12	-104.20	0.00
WoodallUS	-0.58	0.10	-104.11	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-1.17	-0.61	-29.67	0.50
BridgeBlvdDS	-1.00	-0.43	-115.77	-4.50
BridgeBlvdUS	-0.98	-0.31	-44.07	-5.25
BrunnellDS	-1.05	-0.51	-29.68	0.50
ChestnutDS	-0.94	0.23	-122.58	0.25
ChestnutUS	-0.13	0.23	-122.72	0.25
Downstream TW	0.00	0.00	-133.89	**1.75**
GolfcartDS	-0.52	-0.36	-107.35	-0.50
GolfcartUS	-0.74	-0.37	-108.81	-0.25
HowardDS	-0.72	-0.37	-116.31	0.00
HowardUS	-0.88	-0.32	-121.53	0.25
LAGOON	-0.32	0.69	0.02	0.00
Lake Blanton_West	-0.46	-0.36	-107.85	-0.50
Lake bonnet	-0.33	0.69	**31.59**	0.00
LakeBlanton_East	-0.46	-0.36	-107.51	-0.50
MayManorEast	-0.99	-0.37	-78.61	-5.50
MayManorEast_2	-1.00	-0.32	-67.31	-8.25
MayManorEast_3				
MayManorHead	-1.03	-0.42	-35.70	0.50
MayManorWest	-0.99	-0.37	-98.21	-6.00
MHPWEIRDS				
MHPWeirUS				
NC0020	0.00	0.00	0.00	0.00
NC0040	0.00	0.00	0.00	0.00
NC0060	0.00	0.00	0.06	0.00
NC0080	0.00	0.01	0.01	0.00
NC0090	0.00	0.00	-0.01	0.00
NC0100	0.00	0.00	0.00	0.00
NC0120S	0.00	0.01	-0.09	0.00
NC0120Sa	0.00	0.00	0.02	0.00
NC0120Sb	0.00	0.01	0.04	0.00
NC0120Sc	0.00	0.00	0.06	0.00
NC0120Sd	0.00	0.00	0.05	0.00
NC0140	0.00	0.00	-0.06	0.00
NC0160	0.00	0.01	0.10	0.00
NC0180	0.00	0.00	0.03	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.00	-0.07	0.00
NC0240	-0.72	-0.65	0.01	0.00
NC0260	-0.48	-2.55	-0.01	0.00
NC0300	0.00	0.00	0.02	0.00
NC0360	0.00	0.00	-0.01	0.00
NC0365	0.00	0.00	0.00	0.00
NC0370	0.00	0.00	0.09	0.00
NC0380	-0.01	-0.01	0.15	0.00
NC0382	-0.03	-0.05	0.23	0.00
NC0390	0.00	-0.03	0.02	0.00
NC0398	-0.50	-0.09	-116.46	0.00
NC0430	0.00	0.00	0.01	0.00
NC0440	0.00	0.00	0.01	0.00
NC0442	0.00	0.00	0.00	0.00
NC0460	-0.98	0.11	-125.75	0.00
NC0462	-0.45	-0.41	-125.30	0.25
NC0480	-0.33	-0.41	-107.44	-0.50
NC0482	-0.64	-0.82	-107.49	-0.50
NC0500	0.00	0.00	-0.01	0.00
NC0510	0.00	0.00	-0.59	0.00
NC0520	0.00	0.00	-0.44	0.00
NC0540	-0.15	1.10	-97.63	-3.50
NC0540_E1	-0.15	1.19	-106.85	-0.50
NC0540_E2	-0.15	1.22	-223.76	-6.25
NC0540_E3	-0.15	1.20	-107.22	-2.00
NC0540_E4	-0.15	1.16	-95.84	-1.25
NC0540_E5	-0.15	1.17	-92.38	-1.50
NC0560	-0.15	1.20	-3.80	0.25
NC0570	-0.14	1.21	-29.82	0.50
NC0572	-0.15	1.23	-107.49	-0.50
NC0590	-0.10	0.86	-116.45	0.25
NC0620	-0.11	0.83	0.00	0.00
NC0630	-0.10	0.70	-0.57	0.00
NC0631	-0.10	0.90	-115.98	0.25
NC0632	-0.10	0.70	-114.77	0.25
NC0635	-0.10	0.58	-132.97	0.75

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	-0.10	0.78	-134.18	0.75
NC0650	-0.09	0.60	-134.77	**1.00**
NC0660	0.00	0.00	-0.02	0.00
NC0670	0.00	0.00	-0.04	0.00
NC0680	0.00	0.00	-0.01	0.00
NC0700	0.00	0.00	-20.66	-1.75
NC0720	0.00	0.00	-0.21	0.00
NC0722	0.00	0.00	0.06	0.00
NC0740	0.00	0.00	0.01	0.00
NC0760	0.00	0.01	0.06	0.00
NC0780	0.00	0.01	0.01	0.00
NC0781	0.00	0.08	0.39	-0.25
NC0782	0.00	0.07	0.39	-0.50
NC0783	0.00	0.06	0.39	-0.50
NC0784	-0.01	0.06	0.39	-0.50
NC0785	0.00	0.06	0.39	-0.25
NC0787	-0.01	0.08	0.00	0.00
NC0800	-0.15	1.16	-0.98	0.00
NC0820	-0.10	-7.91	0.01	0.00
NC0840	-0.08	-6.94	0.01	0.00
NC0860	-0.08	-6.82	-0.08	0.00
NC0880	-0.08	-6.76	-1.00	-0.25
NC0882	-0.08	0.65	-1.45	0.00
NC0900	0.00	0.00	-0.03	0.00
NC0912	0.00	0.00	-0.07	0.00
NC0920	0.00	0.00	-0.03	0.00
NC0925	0.00	0.00	0.04	0.00
NC0930	0.00	0.00	0.00	0.00
NC0935	0.00	0.00	0.02	0.00
NC0937	-0.08	0.59	-0.01	0.00
NC0940	0.00	0.00	0.00	0.00
NC0950	0.00	0.00	-0.05	0.00
NC0955	-0.08	0.48	-0.06	0.00
NC0960	-0.08	0.55	-0.28	0.00
NC0960_S1	-0.08	0.53	-0.50	0.00
NC0960_S2	-0.09	0.70	-0.09	0.00

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 3 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	-0.08	0.56	0.00	0.00
NC1000	-0.09	0.68	0.05	0.00
NC1020	-0.09	0.59	**1.90**	0.00
NC1030	-0.09	0.75	-3.70	-2.25
NC1035	-0.09	0.68	-0.17	0.00
NC1040	-0.09	0.66	-32.00	**1.75**
NC1050	-0.08	0.66	-25.61	-4.25
NC1060	-0.08	0.64	-139.40	**1.00**
NC1060_E	-0.08	0.66	-135.13	0.75
NC1070	-0.13	0.80	-139.68	0.75
NC1180	0.00	0.00	0.01	0.00
NC1190	-0.11	0.84	0.00	0.00
NC1200	-0.11	0.84	**24.28**	**1.25**
NC1210	-0.11	0.64	-139.72	**1.00**
NC1220	-0.06	0.33	0.08	0.00
NC1230	-0.07	0.42	-0.01	0.00
NC1360	-0.07	0.45	-144.64	**1.25**
NC1362	0.00	-0.05	-139.94	**1.50**
NC1380	-0.07	0.50	-0.04	0.00
NC1382	0.00	0.02	0.00	0.00
NH1042	0.00	0.00	0.00	0.00
NH1044	-0.01	0.00	**3.74**	0.00
NH1060	-0.02	0.03	**3.61**	0.00
NH1060_SA	0.00	0.00	0.23	0.00
NH1080	-0.05	0.41	**3.46**	0.00
NH1082	-0.05	0.39	**3.07**	-0.25
NH1084	-0.09	0.56	**3.00**	0.00
SterlingCanal	-0.99	-0.37	**38.35**	-5.00
SterlingCanal_East	-0.99	-0.37	-2.84	-6.75
SterlingCanal_N	-0.16	-0.29	0.01	0.00
Sump				
WabashDS	-0.58	-0.16	-116.52	0.00
WabashUS	-0.76	-0.18	-116.12	-0.25
WoodallDS	-0.29	0.22	-116.92	0.25
WoodallUS	-0.46	0.18	-116.98	0.25

* Comparison of Existing vs Alt 3, values are stage and flow differences

Positive values (red) are Alt 3 Run 15-40-90 Stage increase.

Positive values (green) are Alt 3 Run 15-40-90 Flow increase >1cfs.

APPENDIX C4

Existing Condition vs Alternative 4 Model Results

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-0.37	5.235	-0.11	0.00
BridgeBlvdDS	-0.53	-1.251	-43.87	4.75
BridgeBlvdUS	-0.52	-1.210	-27.80	4.50
BrunnellDS	-0.50	0.269	-0.12	0.00
ChestnutDS	-0.18	-0.231	-26.58	-0.25
ChestnutUS	-0.03	-0.256	-26.55	-0.25
Downstream TW	0.00	0.000	0.06	1.00
ExMHPWeir	------	------	------	------
GolfcartDS	-0.10	-0.309	-26.66	-0.50
GolfcartUS	-0.16	-0.326	-23.02	-0.50
HowardDS	-0.16	-0.322	-23.32	-0.25
HowardUS	-0.20	-0.316	-23.13	0.00
LAGOON	0.00	0.003	0.00	0.00
Lake Blanton_West	-0.06	-0.320	-27.13	-0.25
Lake bonnet	-0.01	0.004	0.00	0.00
LakeBlanton_East	-0.05	-0.320	-26.94	-0.50
MayManorEast	-0.53	-0.208	0.19	4.00
MayManorEast_2	-0.53	-0.165	25.55	1.00
MayManorHead	-0.52	0.074	7.12	1.00
MayManorWest	-0.52	-1.182	19.69	2.75
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.000	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain

Existing Condition vs Alternative 4 Model Results

2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.000	0.00	0.00
NC0240	-0.52	0.147	-17.32	3.00
NC0260	-0.44	-2.815	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.00	0.000	-0.01	0.00
NC0382	0.00	-0.001	0.00	0.00
NC0390	0.00	0.001	0.00	0.00
NC0398	-0.14	-1.302	-52.91	-1.00
NC0430	0.00	0.000	0.00	0.00
NC0440	0.00	0.000	0.00	0.00
NC0442	0.00	0.001	0.00	0.00
NC0460	-0.15	-0.163	-24.16	-0.25
NC0462	-0.12	-0.359	-24.51	0.00
NC0480	0.11	-0.320	-26.89	-0.25
NC0482	0.43	-1.201	-26.85	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	0.01	0.123	-20.59	-4.00
NC0540_E1	0.01	0.164	-26.18	-0.25
NC0540_E2	0.01	0.149	-54.13	-1.75
NC0540_E3	0.01	0.116	-33.34	-2.25
NC0540_E4	0.00	0.147	-22.90	-1.50
NC0540_E5	0.01	0.203	-20.34	-1.75
NC0560	0.01	0.133	0.15	0.00
NC0570	0.01	0.210	-2.83	0.00
NC0572	0.02	0.100	-26.69	-0.25
NC0590	0.01	0.100	-46.56	0.00
NC0620	0.00	0.165	0.00	0.00
NC0630	0.00	0.049	0.00	0.00
NC0631	0.00	0.138	-46.28	0.00
NC0632	0.01	0.130	-45.55	0.00
NC0635	0.00	0.036	6.48	0.25

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	0.00	0.072	5.57	0.25
NC0650	0.00	0.054	5.61	0.25
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.00	-0.001	-20.66	-1.75
NC0720	0.00	-0.001	0.00	0.00
NC0722	0.00	-0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.001	0.00	0.00
NC0780	0.00	0.000	0.00	0.00
NC0781	0.00	0.061	-0.02	0.00
NC0782	0.00	-0.039	-0.03	-0.25
NC0783	0.00	0.027	-0.02	0.00
NC0784	0.00	0.010	-0.02	0.00
NC0785	0.00	0.022	-0.02	0.00
NC0787	-0.01	0.013	0.01	0.00
NC0800	0.00	0.174	-0.16	0.00
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.06	-6.936	0.00	0.00
NC0860	-0.06	-6.823	0.00	0.00
NC0880	-0.05	-6.758	-0.29	0.00
NC0882	0.01	0.088	0.02	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	0.01	0.104	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	0.00	-0.029	0.00	0.00
NC0960	0.00	-0.001	0.03	0.00
NC0960_S1	0.00	0.118	0.04	0.00
NC0960_S2	0.00	0.089	0.14	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
2.33-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	0.00	0.117	0.00	0.00
NC1000	0.00	0.075	0.00	0.00
NC1020	0.00	0.072	0.11	0.00
NC1030	0.00	0.187	-2.73	-3.25
NC1035	0.00	0.087	0.00	0.00
NC1040	0.00	0.204	-15.72	-4.00
NC1050	0.00	0.142	3.39	-4.00
NC1060	0.00	0.140	4.56	0.25
NC1060_E	0.00	0.057	5.50	0.00
NC1070	0.00	0.084	4.57	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	0.01	0.146	0.00	0.00
NC1200	0.01	0.146	28.15	1.25
NC1210	0.01	0.025	4.50	0.25
NC1220	0.00	0.011	0.00	0.00
NC1230	0.00	-0.024	0.00	0.00
NC1360	0.00	-0.006	-2.36	0.25
NC1362	0.00	0.006	-2.99	0.50
NC1380	0.01	0.013	0.00	0.00
NC1382	0.00	-0.011	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.016	-0.03	0.00
NH1060	0.00	0.006	-0.06	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.088	-0.08	0.00
NH1082	0.00	0.039	-0.16	-0.25
NH1084	0.01	0.070	-0.20	0.00
SterlingCanal	-0.53	-1.208	-19.73	5.00
SterlingCanal_East	-0.53	-1.236	-4.54	3.75
SterlingCanal_N	-0.07	-0.117	0.00	0.00
WabashDS	-0.18	-1.421	-52.99	-1.00
WabashUS	-0.30	-1.347	-56.18	0.25
WoodallDS	-0.08	-0.285	-36.29	-0.50
WoodallUS	-0.12	-0.480	-36.35	-0.50

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-0.37	5.235	-0.11	0.00
BridgeBlvdDS	-0.53	-1.251	-43.87	4.75
BridgeBlvdUS	-0.52	-1.210	-27.80	4.50
BrunnellDS	-0.50	0.269	-0.12	0.00
ChestnutDS	-0.18	-0.231	-26.58	-0.25
ChestnutUS	-0.03	-0.256	-26.55	-0.25
Downstream TW	0.00	0.000	0.06	1.00
ExMHPWeir	------	------	------	------
GolfcartDS	-0.10	-0.309	-26.66	-0.50
GolfcartUS	-0.16	-0.326	-23.02	-0.50
HowardDS	-0.16	-0.322	-23.32	-0.25
HowardUS	-0.20	-0.316	-23.13	0.00
LAGOON	0.00	0.003	0.00	0.00
Lake Blanton_West	-0.06	-0.320	-27.13	-0.25
Lake bonnet	-0.01	0.004	0.00	0.00
LakeBlanton_East	-0.05	-0.320	-26.94	-0.50
MayManorEast	-0.53	-0.208	0.19	4.00
MayManorEast_2	-0.53	-0.165	25.55	1.00
MayManorHead	-0.52	0.074	7.12	1.00
MayManorWest	-0.52	-1.182	19.69	2.75
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.000	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.000	0.00	0.00
NC0240	-0.52	0.147	-17.32	3.00
NC0260	-0.44	-2.815	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.00	0.000	-0.01	0.00
NC0382	0.00	-0.001	0.00	0.00
NC0390	0.00	0.001	0.00	0.00
NC0398	-0.14	-1.302	-52.91	-1.00
NC0430	0.00	0.000	0.00	0.00
NC0440	0.00	0.000	0.00	0.00
NC0442	0.00	0.001	0.00	0.00
NC0460	-0.15	-0.163	-24.16	-0.25
NC0462	-0.12	-0.359	-24.51	0.00
NC0480	0.11	-0.320	-26.89	-0.25
NC0482	0.43	-1.201	-26.85	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	0.01	0.123	-20.59	-4.00
NC0540_E1	0.01	0.164	-26.18	-0.25
NC0540_E2	0.01	0.149	-54.13	-1.75
NC0540_E3	0.01	0.116	-33.34	-2.25
NC0540_E4	0.00	0.147	-22.90	-1.50
NC0540_E5	0.01	0.203	-20.34	-1.75
NC0560	0.01	0.133	0.15	0.00
NC0570	0.01	0.210	-2.83	0.00
NC0572	0.02	0.100	-26.69	-0.25
NC0590	0.01	0.100	-46.56	0.00
NC0620	0.00	0.165	0.00	0.00
NC0630	0.00	0.049	0.00	0.00
NC0631	0.00	0.138	-46.28	0.00
NC0632	0.01	0.130	-45.55	0.00
NC0635	0.00	0.036	6.48	0.25

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	0.00	0.072	5.57	0.25
NC0650	0.00	0.054	5.61	0.25
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.00	-0.001	-20.66	-1.75
NC0720	0.00	-0.001	0.00	0.00
NC0722	0.00	-0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.001	0.00	0.00
NC0780	0.00	0.000	0.00	0.00
NC0781	0.00	0.061	-0.02	0.00
NC0782	0.00	-0.039	-0.03	-0.25
NC0783	0.00	0.027	-0.02	0.00
NC0784	0.00	0.010	-0.02	0.00
NC0785	0.00	0.022	-0.02	0.00
NC0787	-0.01	0.013	0.01	0.00
NC0800	0.00	0.174	-0.16	0.00
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.06	-6.936	0.00	0.00
NC0860	-0.06	-6.823	0.00	0.00
NC0880	-0.05	-6.758	-0.29	0.00
NC0882	0.01	0.088	0.02	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	0.01	0.104	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	0.00	-0.029	0.00	0.00
NC0960	0.00	-0.001	0.03	0.00
NC0960_S1	0.00	0.118	0.04	0.00
NC0960_S2	0.00	0.089	0.14	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
10-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	0.00	0.117	0.00	0.00
NC1000	0.00	0.075	0.00	0.00
NC1020	0.00	0.072	0.11	0.00
NC1030	0.00	0.187	-2.73	-3.25
NC1035	0.00	0.087	0.00	0.00
NC1040	0.00	0.204	-15.72	-4.00
NC1050	0.00	0.142	3.39	-4.00
NC1060	0.00	0.140	4.56	0.25
NC1060_E	0.00	0.057	5.50	0.00
NC1070	0.00	0.084	4.57	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	0.01	0.146	0.00	0.00
NC1200	0.01	0.146	28.15	1.25
NC1210	0.01	0.025	4.50	0.25
NC1220	0.00	0.011	0.00	0.00
NC1230	0.00	-0.024	0.00	0.00
NC1360	0.00	-0.006	-2.36	0.25
NC1362	0.00	0.006	-2.99	0.50
NC1380	0.01	0.013	0.00	0.00
NC1382	0.00	-0.011	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.016	-0.03	0.00
NH1060	0.00	0.006	-0.06	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.088	-0.08	0.00
NH1082	0.00	0.039	-0.16	-0.25
NH1084	0.01	0.070	-0.20	0.00
SterlingCanal	-0.53	-1.208	-19.73	5.00
SterlingCanal_East	-0.53	-1.236	-4.54	3.75
SterlingCanal_N	-0.07	-0.117	0.00	0.00
WabashDS	-0.18	-1.421	-52.99	-1.00
WabashUS	-0.30	-1.347	-56.18	0.25
WoodallDS	-0.08	-0.285	-36.29	-0.50
WoodallUS	-0.12	-0.480	-36.35	-0.50

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-0.37	5.235	-0.11	0.00
BridgeBlvdDS	-0.53	-1.251	-43.87	4.75
BridgeBlvdUS	-0.52	-1.210	-27.80	4.50
BrunnellDS	-0.50	0.269	-0.12	0.00
ChestnutDS	-0.18	-0.231	-26.58	-0.25
ChestnutUS	-0.03	-0.256	-26.55	-0.25
Downstream TW	0.00	0.000	0.06	1.00
ExMHPWeir	------	------	------	------
GolfcartDS	-0.10	-0.309	-26.66	-0.50
GolfcartUS	-0.16	-0.326	-23.02	-0.50
HowardDS	-0.16	-0.322	-23.32	-0.25
HowardUS	-0.20	-0.316	-23.13	0.00
LAGOON	0.00	0.003	0.00	0.00
Lake Blanton_West	-0.06	-0.320	-27.13	-0.25
Lake bonnet	-0.01	0.004	0.00	0.00
LakeBlanton_East	-0.05	-0.320	-26.94	-0.50
MayManorEast	-0.53	-0.208	0.19	4.00
MayManorEast_2	-0.53	-0.165	25.55	1.00
MayManorHead	-0.52	0.074	7.12	1.00
MayManorWest	-0.52	-1.182	19.69	2.75
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.000	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.000	0.00	0.00
NC0240	-0.52	0.147	-17.32	3.00
NC0260	-0.44	-2.815	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.00	0.000	-0.01	0.00
NC0382	0.00	-0.001	0.00	0.00
NC0390	0.00	0.001	0.00	0.00
NC0398	-0.14	-1.302	-52.91	-1.00
NC0430	0.00	0.000	0.00	0.00
NC0440	0.00	0.000	0.00	0.00
NC0442	0.00	0.001	0.00	0.00
NC0460	-0.15	-0.163	-24.16	-0.25
NC0462	-0.12	-0.359	-24.51	0.00
NC0480	0.11	-0.320	-26.89	-0.25
NC0482	0.43	-1.201	-26.85	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	0.01	0.123	-20.59	-4.00
NC0540_E1	0.01	0.164	-26.18	-0.25
NC0540_E2	0.01	0.149	-54.13	-1.75
NC0540_E3	0.01	0.116	-33.34	-2.25
NC0540_E4	0.00	0.147	-22.90	-1.50
NC0540_E5	0.01	0.203	-20.34	-1.75
NC0560	0.01	0.133	0.15	0.00
NC0570	0.01	0.210	-2.83	0.00
NC0572	0.02	0.100	-26.69	-0.25
NC0590	0.01	0.100	-46.56	0.00
NC0620	0.00	0.165	0.00	0.00
NC0630	0.00	0.049	0.00	0.00
NC0631	0.00	0.138	-46.28	0.00
NC0632	0.01	0.130	-45.55	0.00
NC0635	0.00	0.036	6.48	0.25

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	0.00	0.072	5.57	0.25
NC0650	0.00	0.054	5.61	0.25
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.00	-0.001	-20.66	-1.75
NC0720	0.00	-0.001	0.00	0.00
NC0722	0.00	-0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.001	0.00	0.00
NC0780	0.00	0.000	0.00	0.00
NC0781	0.00	0.061	-0.02	0.00
NC0782	0.00	-0.039	-0.03	-0.25
NC0783	0.00	0.027	-0.02	0.00
NC0784	0.00	0.010	-0.02	0.00
NC0785	0.00	0.022	-0.02	0.00
NC0787	-0.01	0.013	0.01	0.00
NC0800	0.00	0.174	-0.16	0.00
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.06	-6.936	0.00	0.00
NC0860	-0.06	-6.823	0.00	0.00
NC0880	-0.05	-6.758	-0.29	0.00
NC0882	0.01	0.088	0.02	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	0.01	0.104	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	0.00	-0.029	0.00	0.00
NC0960	0.00	-0.001	0.03	0.00
NC0960_S1	0.00	0.118	0.04	0.00
NC0960_S2	0.00	0.089	0.14	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
25-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	0.00	0.117	0.00	0.00
NC1000	0.00	0.075	0.00	0.00
NC1020	0.00	0.072	0.11	0.00
NC1030	0.00	0.187	-2.73	-3.25
NC1035	0.00	0.087	0.00	0.00
NC1040	0.00	0.204	-15.72	-4.00
NC1050	0.00	0.142	3.39	-4.00
NC1060	0.00	0.140	4.56	0.25
NC1060_E	0.00	0.057	5.50	0.00
NC1070	0.00	0.084	4.57	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	0.01	0.146	0.00	0.00
NC1200	0.01	0.146	28.15	1.25
NC1210	0.01	0.025	4.50	0.25
NC1220	0.00	0.011	0.00	0.00
NC1230	0.00	-0.024	0.00	0.00
NC1360	0.00	-0.006	-2.36	0.25
NC1362	0.00	0.006	-2.99	0.50
NC1380	0.01	0.013	0.00	0.00
NC1382	0.00	-0.011	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.016	-0.03	0.00
NH1060	0.00	0.006	-0.06	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.088	-0.08	0.00
NH1082	0.00	0.039	-0.16	-0.25
NH1084	0.01	0.070	-0.20	0.00
SterlingCanal	-0.53	-1.208	-19.73	5.00
SterlingCanal_East	-0.53	-1.236	-4.54	3.75
SterlingCanal_N	-0.07	-0.117	0.00	0.00
WabashDS	-0.18	-1.421	-52.99	-1.00
WabashUS	-0.30	-1.347	-56.18	0.25
WoodallDS	-0.08	-0.285	-36.29	-0.50
WoodallUS	-0.12	-0.480	-36.35	-0.50

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
BonnetControl	-0.37	5.235	-0.11	0.00
BridgeBlvdDS	-0.53	-1.251	-43.87	4.75
BridgeBlvdUS	-0.52	-1.210	-27.80	4.50
BrunnellDS	-0.50	0.269	-0.12	0.00
ChestnutDS	-0.18	-0.231	-26.58	-0.25
ChestnutUS	-0.03	-0.256	-26.55	-0.25
Downstream TW	0.00	0.000	0.06	1.00
ExMHPWeir	------	------	------	------
GolfcartDS	-0.10	-0.309	-26.66	-0.50
GolfcartUS	-0.16	-0.326	-23.02	-0.50
HowardDS	-0.16	-0.322	-23.32	-0.25
HowardUS	-0.20	-0.316	-23.13	0.00
LAGOON	0.00	0.003	0.00	0.00
Lake Blanton_West	-0.06	-0.320	-27.13	-0.25
Lake bonnet	-0.01	0.004	0.00	0.00
LakeBlanton_East	-0.05	-0.320	-26.94	-0.50
MayManorEast	-0.53	-0.208	0.19	4.00
MayManorEast_2	-0.53	-0.165	25.55	1.00
MayManorHead	-0.52	0.074	7.12	1.00
MayManorWest	-0.52	-1.182	19.69	2.75
MHPWEIRDS	------	------	------	------
MHPWeirUS	------	------	------	------
NC0020	0.00	0.000	0.00	0.00
NC0040	0.00	0.000	0.00	0.00
NC0060	0.00	0.000	0.00	0.00
NC0080	0.00	0.000	0.00	0.00
NC0090	0.00	-0.001	0.00	0.00
NC0100	0.00	0.000	0.00	0.00
NC0120S	0.00	0.000	0.00	0.00
NC0120Sa	0.00	0.000	0.00	0.00
NC0120Sb	0.00	-0.001	0.00	0.00
NC0120Sc	0.00	0.001	0.00	0.00
NC0120Sd	0.00	0.000	0.00	0.00
NC0140	0.00	0.000	0.00	0.00
NC0160	0.00	0.000	0.00	0.00
NC0180	0.00	0.000	0.00	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0200	0.00	0.000	0.00	0.00
NC0240	-0.52	0.147	-17.32	3.00
NC0260	-0.44	-2.815	0.00	0.00
NC0300	0.00	0.000	0.00	0.00
NC0360	0.00	0.000	0.00	0.00
NC0365	0.00	-0.001	0.00	0.00
NC0370	0.00	0.000	0.00	0.00
NC0380	0.00	0.000	-0.01	0.00
NC0382	0.00	-0.001	0.00	0.00
NC0390	0.00	0.001	0.00	0.00
NC0398	-0.14	-1.302	-52.91	-1.00
NC0430	0.00	0.000	0.00	0.00
NC0440	0.00	0.000	0.00	0.00
NC0442	0.00	0.001	0.00	0.00
NC0460	-0.15	-0.163	-24.16	-0.25
NC0462	-0.12	-0.359	-24.51	0.00
NC0480	0.11	-0.320	-26.89	-0.25
NC0482	0.43	-1.201	-26.85	-0.25
NC0500	0.00	0.000	0.00	0.00
NC0510	0.00	0.000	0.00	0.00
NC0520	0.00	0.000	0.00	0.00
NC0540	0.01	0.123	-20.59	-4.00
NC0540_E1	0.01	0.164	-26.18	-0.25
NC0540_E2	0.01	0.149	-54.13	-1.75
NC0540_E3	0.01	0.116	-33.34	-2.25
NC0540_E4	0.00	0.147	-22.90	-1.50
NC0540_E5	0.01	0.203	-20.34	-1.75
NC0560	0.01	0.133	0.15	0.00
NC0570	0.01	0.210	-2.83	0.00
NC0572	0.02	0.100	-26.69	-0.25
NC0590	0.01	0.100	-46.56	0.00
NC0620	0.00	0.165	0.00	0.00
NC0630	0.00	0.049	0.00	0.00
NC0631	0.00	0.138	-46.28	0.00
NC0632	0.01	0.130	-45.55	0.00
NC0635	0.00	0.036	6.48	0.25

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0640	0.00	0.072	5.57	0.25
NC0650	0.00	0.054	5.61	0.25
NC0660	0.00	0.000	0.00	0.00
NC0670	0.00	0.000	0.00	0.00
NC0680	0.00	0.000	0.00	0.00
NC0700	0.00	-0.001	-20.66	-1.75
NC0720	0.00	-0.001	0.00	0.00
NC0722	0.00	-0.011	0.00	0.00
NC0740	0.00	0.000	0.00	0.00
NC0760	0.00	-0.001	0.00	0.00
NC0780	0.00	0.000	0.00	0.00
NC0781	0.00	0.061	-0.02	0.00
NC0782	0.00	-0.039	-0.03	-0.25
NC0783	0.00	0.027	-0.02	0.00
NC0784	0.00	0.010	-0.02	0.00
NC0785	0.00	0.022	-0.02	0.00
NC0787	-0.01	0.013	0.01	0.00
NC0800	0.00	0.174	-0.16	0.00
NC0820	-0.07	-7.913	0.00	0.00
NC0840	-0.06	-6.936	0.00	0.00
NC0860	-0.06	-6.823	0.00	0.00
NC0880	-0.05	-6.758	-0.29	0.00
NC0882	0.01	0.088	0.02	0.00
NC0900	0.00	0.000	0.00	0.00
NC0912	0.00	0.000	0.00	0.00
NC0920	0.00	0.000	0.00	0.00
NC0925	0.00	0.000	0.00	0.00
NC0930	0.00	0.000	0.00	0.00
NC0935	0.00	0.000	0.00	0.00
NC0937	0.01	0.104	0.00	0.00
NC0940	0.00	0.000	0.00	0.00
NC0950	0.00	0.000	0.00	0.00
NC0955	0.00	-0.029	0.00	0.00
NC0960	0.00	-0.001	0.03	0.00
NC0960_S1	0.00	0.118	0.04	0.00
NC0960_S2	0.00	0.089	0.14	0.00

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

Lake Bonnet Drain
Existing Condition vs Alternative 4 Model Results
100-Yr, 24 Hours Storm Event

Node Name	(*)Max Stage [ft]	(*)Time to Max [hrs]	(*)Max Total Inflow Rate [cfs]	(*)Time to Max Inflow Rate [hrs]
NC0980	0.00	0.117	0.00	0.00
NC1000	0.00	0.075	0.00	0.00
NC1020	0.00	0.072	0.11	0.00
NC1030	0.00	0.187	-2.73	-3.25
NC1035	0.00	0.087	0.00	0.00
NC1040	0.00	0.204	-15.72	-4.00
NC1050	0.00	0.142	3.39	-4.00
NC1060	0.00	0.140	4.56	0.25
NC1060_E	0.00	0.057	5.50	0.00
NC1070	0.00	0.084	4.57	0.00
NC1180	0.00	0.000	0.00	0.00
NC1190	0.01	0.146	0.00	0.00
NC1200	0.01	0.146	28.15	1.25
NC1210	0.01	0.025	4.50	0.25
NC1220	0.00	0.011	0.00	0.00
NC1230	0.00	-0.024	0.00	0.00
NC1360	0.00	-0.006	-2.36	0.25
NC1362	0.00	0.006	-2.99	0.50
NC1380	0.01	0.013	0.00	0.00
NC1382	0.00	-0.011	0.00	0.00
NH1042	0.00	0.000	0.00	0.00
NH1044	0.00	-0.016	-0.03	0.00
NH1060	0.00	0.006	-0.06	0.00
NH1060_SA	0.00	0.000	0.00	0.00
NH1080	0.00	0.088	-0.08	0.00
NH1082	0.00	0.039	-0.16	-0.25
NH1084	0.01	0.070	-0.20	0.00
SterlingCanal	-0.53	-1.208	-19.73	5.00
SterlingCanal_East	-0.53	-1.236	-4.54	3.75
SterlingCanal_N	-0.07	-0.117	0.00	0.00
WabashDS	-0.18	-1.421	-52.99	-1.00
WabashUS	-0.30	-1.347	-56.18	0.25
WoodallDS	-0.08	-0.285	-36.29	-0.50
WoodallUS	-0.12	-0.480	-36.35	-0.50

* Comparison of Existing vs Alt 4, values are stage and flow differences

Positive values (red) are Alt 4 Run JMR Stage increase.

Positive values (green) are Alt 4 Run JMR Flow increase >1cfs.

APPENDIX D

ENGINEER'S OPINION OF PROBABLE COST

APPENDIX D1

Engineer’s Opinion of Probable Cost

Alternative 1 – Channel Improvement (Berms / Floodwalls)

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 1 - Channel Improvement (Berms / Floodwalls)

Item	Unit	Quantity	Unit Cost	Cost
Earthwork:				
Lake Bonnet Drain (LBD) Dredging	CY	10,300	$ 87	$ 896,100
LBD Berm Grading	CY	10,465	$ 19	$ 200,823
Hydroseeding	SY	45,000	$ 3	$ 151,200
6" Topsoil	SY	19,000	$ 9	$ 170,240
10' Wide Gravel Access Path (6" thick)	LF	200	$ 50	$ 10,000
Structural:				
LBD Flood Wall (10-ft Deep Sheet Pile with Concrete Cap)	LF	3,652	$ 515	$ 1,879,465
Reconstruct May Manor Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Reconstruct Bridge Blvd Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Modify Lake Bonnet outlet control structure to open from top instead of bottom	EA	1	$ 183,312	$ 183,312
Overbank Sump Pumps				
8 MGD (15 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	12	$ 16,667	$ 200,000
Concrete for 8 MGD Wetwell (Assume 10" thick Concrete)	CY	13	$ 1,294	$ 16,827
16 MGD (30 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	4	$ 100,000	$ 400,000
Concrete for 16 MGD Wetwell (Assume 10" thick Concrete)	CY	21	$ 1,294	$ 27,181
3-Phase Electrical Power (i.e., cable and conduit)	LF	6,000	$ 69	$ 414,780
Sump Pump Permanent Emergency Generator (250kw assumed)	Each	8	$ 69,087	$ 552,694
4' x 4' x 4' Catch Basins/ Manholes	Each	12	$ 6,211	$ 74,529
24" HDPE Drainage Pipes	LF	5,000	$ 116	$ 577,800
Sterling Canal Extension				
58" H x 91" W Elliptical Class V RCP	LF	425	$ 718	$ 305,006
10'W x 6'L x 8'D Cast-in-Place Transition Box from Existing 42" HDPE to Proposed 58" x 91" Elliptical RCP	Each	1	$ 6,144	$ 6,144
Outlet Headwall for 58" x 91" Elliptical RCP	Each	1	$ 22,729	$ 22,729
72" Tideflex Series 37G Inline Check Valve at Outlet Headwall	Each	1	$ 13,103	$ 13,103
Demolition				
Remove Sterling Weir (25CY Assumed)	LS	1	$ 3,777	$ 3,777
Remove existing berms (3491 CY Assumed 5' Wx 6'D)	CY	3,491	$ 23	$ 81,445
Remove May Manor Crossing (Double Box Culverts)	LS	1	$ 27,987	$ 27,987
Remove Bridge Blvd Crossing (Triple Culverts)	LS	1	$ 29,481	$ 29,481
Land Acquisition (Allowance)				
Temporary easement for construction	LS	1	$ 600,000	$ 600,000
Permanent easement for maintenance and operation	LS	1	$ 100,000	$ 100,000
Subtotal				**$ 7,115,730**
Escalation @ 5.6% annually to MOC				$ 796,962
Direct Costs Incl. Escalation				**$ 7,912,692**
Construction				
Contingency@50%	LS	1	$ 3,956,346	$ 3,956,346
Mobilization/Demobilization @10%	LS	1	$ 791,269	$ 791,269
MOT @10%	LS	1	$ 791,269	$ 791,269
Construction Oversight & Inspection @10%	LS	1	$ 791,269	$ 791,269
Field Office @ 1%	LS	1	$ 79,127	$ 79,127

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 1 - Channel Improvement (Berms / Floodwalls)

Item	Unit	Quantity	Unit Cost	Cost
Construction Staging Area @1%	LS	1	$ 79,127	$ 79,127
Survey & Layout @2%	LS	1	$ 158,254	$ 158,254
Erosion & Sediment Control @3%	LS	1	$ 237,381	$ 237,381
Temporary Bypass and Dewatering for Construction - Assumed 2 Years of Dewatering	DAYS	730	$ 2,000	$ 1,460,000
Temporary Utilities - Allowance	LS	1	$ 500,000	$ 500,000
Construction Site Security	LS	1	$ 50,000	$ 50,000
				$ 16,806,734

APPENDIX D2

Engineer’s Opinion of Probable Cost

Alternative 2 – Channel Improvement (Floodwalls)

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 2 - Channel Improvement (Floodwalls)

Item	Unit	Quantity	Unit Cost	Cost
Earthwork:				
Lake Bonnet Drain (LBD) Dredging	CY	14,150	$ 87	$ 1,231,050
LBD Berm Grading	CY	3,435	$ 19	$ 65,918
Hydroseeding	SY	45,000	$ 3	$ 151,200
6" Topsoil	SY	19,000	$ 9	$ 170,240
10' Wide Gravel Access Path (6" thick)	LF	200	$ 50	$ 10,000
Structural:				
LBD Flood Wall (10-ft Deep Sheet Pile with Concrete Cap)	LF	6,910	$ 515	$ 3,556,162
Reconstruct May Manor Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Reconstruct Bridge Blvd Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Modify Lake Bonnet outlet control structure to open from top instead of bottom	EA	1	$ 183,312	$ 183,312
Overbank Sump Pumps				
8 MGD (15 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	12	$ 16,667	$ 200,000
Concrete for 8 MGD Wetwell (Assume 10" thick Concrete)	CY	13	$ 1,294	$ 16,827
16 MGD (30 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	4	$ 100,000	$ 400,000
Concrete for 16 MGD Wetwell (Assume 10" thick Concrete)	CY	21	$ 1,294	$ 27,181
3-Phase Electrical Power (i.e., cable and conduit)	LF	6,000	$ 69	$ 414,780
Sump Pump Permanent Emergency Generator (250kw assumed)	Each	8	$ 69,087	$ 552,694
4' x 4' x 4' Catch Basins/ Manholes	Each	12	$ 6,211	$ 74,529
24" HDPE Drainage Pipes	LF	5,000	$ 116	$ 577,800
Sterling Canal Extension				
58" H x 91" W Elliptical Class V RCP	LF	425	$ 718	$ 305,006
10'W x 6'L x 8'D Cast-in-Place Transition Box from Existing 42" HDPE to Proposed 58" x 91" Elliptical RCP	Each	1	$ 6,144	$ 6,144
Outlet Headwall for 58" x 91" Elliptical RCP	Each	1	$ 22,729	$ 22,729
72" Tideflex Series 37G Inline Check Valve at Outlet Headwall	Each	1	$ 13,103	$ 13,103
Demolition				
Remove Sterling Weir (25CY Assumed)	LS	1	$ 3,777	$ 3,777
Remove existing berms (3491 CY Assumed 5' W x 6'D)	CY	3,491	$ 23	$ 81,445
Remove May Manor Crossing (Double Box Culverts)	LS	1	$ 27,987	$ 27,987
Remove Bridge Blvd Crossing (Triple Culverts)	LS	1	$ 29,481	$ 29,481
Land Acquisition (Allowance)				
Temporary easement for construction	LS	1	$ 600,000	$ 600,000
Permanent easement for maintenance and operation	LS	1	$ 100,000	$ 100,000
Subtotal				**$ 8,992,471**
Escalation @ 5.6% annually to MOC				$ 1,007,157
Direct Costs Incl. Escalation				**$ 9,999,628**
Construction				
Contingency@50%	LS	1	$ 4,999,814	$ 4,999,814
Mobilization/Demobilization @10%	LS	1	$ 999,963	$ 999,963
MOT @10%	LS	1	$ 999,963	$ 999,963
Construction Oversight & Inspection @10%	LS	1	$ 999,963	$ 999,963
Field Office @ 1%	LS	1	$ 99,996	$ 99,996

Lake Bonnet Drain
Engineer's Opinion of Probable Cost
Alternative 2 - Channel Improvement (Floodwalls)

Item	Unit	Quantity	Unit Cost	Cost
Construction Staging Area @1%	LS	1	$ 99,996	$ 99,996
Survey & Layout @2%	LS	1	$ 199,993	$ 199,993
Erosion & Sediment Control @3%	LS	1	$ 299,989	$ 299,989
Temporary Bypass and Dewatering for Construction - Assumed 2 Years of Dewatering	DAYS	730	$ 2,000	$ 1,460,000
Temporary Utilities - Allowance	LS	1	$ 500,000	$ 30,000
Construction Site Security	LS	1	$ 50,000	$ 45,000
				$ 20,234,305

APPENDIX D3

Engineer’s Opinion of Probable Cost

Alternative 3 – Backpumping to Lake Bonnet

Lake Bonnet Drain
Engineer's Opinion of Probable Cost
Alternative 3 - Backpumping to Lake Bonnet

Item	Unit	Quantity	Unit Cost	Cost
Earthwork:				
Lake Bonnet Drain (LBD) Dredging	CY	12,105	$ 87	$ 1,053,116
Hydroseeding	SY	40,000	$ 3	$ 134,400
6" Topsoil	SY	31,000	$ 9	$ 277,760
10' Wide Gravel Access Path (6" thick)	LF	100	$ 50	$ 5,000
Regrade and plant wetland vegetation along Lake Bonnet shoreline	SY	4,500	$ 41	$ 185,355
Structural:				
Reconstruct May Manor Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Reconstruct Bridge Blvd Crossing with triple 8'x4' concrete box culvert and raise road elevation by 3 feet	EA	1	$ 85,554	$ 85,554
Modify Lake Bonnet outlet control structure to open from top instead of bottom	EA	1	$ 183,312	$ 183,312
Reconstruct Sterling Weir (15ft Length)	EA	1	$ 183,312	$ 183,312
Harden Lake Bonnet Embankment at Brunnell Parkway (6-inch Riprap)	SY	2,000	$ 195	$ 389,540
Overbank Sump Pumps				
16 MGD (30 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	4	$ 100,000	$ 400,000
Concrete for 16 MGD Wetwell (Assume 10" thick Concrete)	CY	21	$ 1,294	$ 27,181
3-Phase Electrical Power (i.e., cable and conduit)	LF	6,000	$ 69	$ 414,780
Sump Pump Permanent Emergency Generator (250kw assumed)	Each	2	$ 69,087	$ 138,174
4' x 4' x 4' Catch Basins/ Manholes	Each	6	$ 6,211	$ 37,264
24" HDPE Drainage Pipes	LF	1,000	$ 116	$ 115,560
Channel Pumps				
8 MGD (15 cfs) Axial Flow Pumps (i.e., wetwells, pumps, controls)	Each	2	$ 16,667	$ 33,333
14 MGD (25 cfs) Axial Flow Pumps (i.e., wetwells, pumps, controls)	Each	2	$ 100,000	$ 200,000
65 MGD (100cfs) Axial Flow Pumps (i.e., pumps, controls)	Each	2	$ 133,333	$ 266,667
Concrete for 65 MGD Wetwell (Assume 10" thick Concrete)	CY	30	$ 1,294	$ 38,831
20' x 15' Pump House for 65 MGD Pumps	Each	1	$ 98,645	$ 98,645
3-Phase Electrical Power (i.e., cable and conduit)	LF	70	$ 69	$ 4,839
Channel Pump Permanent Emergency Generator (250kw assumed)	Each	1	$ 69,087	$ 69,087
10-ft High Security Perimeter Fence	LF	350	$ 14	$ 5,009
Sterling Canal Extension				
58" H x 91" W Elliptical Class V RCP	LF	425	$ 718	$ 305,006
10'W x 6'L x 8'D Cast-in-Place Transition Box from Existing 42" HDPE to Proposed 58" x 91" Elliptical RCP	Each	1	$ 6,144	$ 6,144
Outlet Headwall for 58" x 91" Elliptical RCP	Each	1	$ 22,729	$ 22,729
72" Tideflex Series 37G Inline Check Valve at Outlet Headwall	Each	1	$ 13,103	$ 13,103
Demolition				
Remove Sterling Weir (25CY Assumed)	LS	1	$ 3,777	$ 3,777
Land Acquisition (Allowance)				
Temporary easement for construction	LS	1	$ 600,000	$ 600,000
Permanent easement for maintenance and operation	LS	1	$ 100,000	$ 100,000
Subtotal				**$ 5,483,030**
Escalation @ 5.6% annually to MOC				$ 614,099
Direct Costs Incl. Escalation				**$ 6,097,129**

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 3 - Backpumping to Lake Bonnet

Item	Unit	Quantity	Unit Cost	Cost
Construction				
Contingency@50%	LS	1	$ 3,048,564	$ 3,048,564
Mobilization/Demobilization @10%	LS	1	$ 609,713	$ 609,713
MOT @10%	LS	1	$ 609,713	$ 609,713
Construction Oversight & Inspection @10%	LS	1	$ 609,713	$ 609,713
Field Office @ 1%	LS	1	$ 60,971	$ 60,971
Construction Staging Area @1%	LS	1	$ 60,971	$ 60,971
Survey & Layout @2%	LS	1	$ 121,943	$ 121,943
Erosion & Sediment Control @3%	LS	1	$ 182,914	$ 182,914
Temporary Bypass and Dewatering for Construction - Assumed 2 Years of Dewatering	DAYS	730	$ 2,000	$ 1,460,000
Temporary Utilities - Allowance	LS	1	$ 500,000	$ 30,000
Construction Site Security	LS	1	$ 50,000	$ 45,000
				$ 12,936,631
Lake Bonnet Dredging - Sediment Removal (Refer to Appendix J - Dredging and Dewatering Alternatives Analysis for cost breakdown)				$ 7,373,073
			Total:	**$ 20,309,704**

APPENDIX D4

Engineer’s Opinion of Probable Cost

Alternative 4 – Detention (Pond / Underground Detention)

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 4 - Detention (Pond / Underground Storage)

Item	Unit	Quantity	Unit Cost	Cost
Earthwork:				
Lake Bonnet Drain (LBD) Dredging	CY	10,300	$ 87	$ 896,100
Hydroseeding	SY	45,000	$ 3	$ 151,200
6" Topsoil	SY	19,000	$ 9	$ 170,240
Structural:				
Modify Lake Bonnet outlet control structure to open from top instead of bottom	EA	1	$ 183,312	$ 183,312
Underground Detention System - Excavation	CY	19,197	$ 26	$ 496,627
Underground Detention System - Material Haul Off (25% Swell)	CY	24,657	$ 12	$ 306,245
Underground Detention System - Backfill and Compactation	CY	1,920	$ 6	$ 11,749
Underground Detention System - Waterproofing (EPDM)	SF	120,176	$ 3	$ 374,948
Underground Detention System - Storm Capture System Delivered	SF	117,800	$ 72	$ 8,518,000
Underground Detention System - Installation	SF	117,800	$ 32	$ 3,769,600
Underground Detention System - Dewatering	LF	11,780	$ 30	$ 353,400
Detention Pond				
Permitting	LS	1	$ 20,000	$ 20,000
Site Clearing and grubbing	AC	2	$ 15,000	$ 30,000
Erosion Control	SY	7,134	$ 7	$ 52,580
Excavation	BCY	16,600	$ 26	$ 429,442
Material Haul Off	LCY	20,750	$ 12	$ 257,715
Bank Stabilization/Erosion Control - Riprap	CY	150	$ 33	$ 4,950
Final Inspections	LS	1	$ 15,000	$ 15,000
Maintenance & Adjustments (6 months)	MO	6	$ 5,000	$ 30,000
Outlet Structure (6'x6')	LS	1	$ 6,012	$ 6,012
Reinforced Concrete Pipe (24")	LF	670	$ 87	$ 58,444
Excavation	CY	397	$ 26	$ 10,271
Material Haul Off	CY	496	$ 12	$ 6,164
Compaction and Infill	CY	319	$ 6	$ 1,953
Headwall	LF	200	$ 38	$ 7,530
Overbank Sump Pumps				
16 MGD (30 cfs) Overbank Sump Pumps (i.e., wetwells, pumps, controls)	Each	3	$ 100,000	$ 300,000
3-Phase Electrical Power (i.e., cable and conduit)	LF	6,000	$ 69	$ 414,780
Sump Pump Permanent Emergency Generator (250kw assumed)	Each	3	$ 69,087	$ 207,260
Sterling Canal Extension				
58" H x 91" W Elliptical Class V RCP	LF	425	$ 718	$ 305,006
10'W x 6'L x 8'D Cast-in-Place Transition Box from Existing 42" HDPE to Proposed 58" x 91" Elliptical RCP	Each	1	$ 6,144	$ 6,144
Outlet Headwall for 58" x 91" Elliptical RCP	Each	1	$ 22,729	$ 22,729
72" Tideflex Series 37G Inline Check Valve at Outlet Headwall	Each	1	$ 13,103	$ 13,103
Demolition				
Remove Sterling Weir (25CY Assumed)	LS	1	$ 3,777	$ 3,777
Land Acquisition (Allowance)				
Temporary easement for construction	LS	1	$ 600,000	$ 600,000
Permanent easement for maintenance and operation	LS	1	$ 100,000	$ 100,000
Subtotal				**$ 18,134,281**
Escalation @ 5.6% annually to MOC				$ 2,031,039

Lake Bonnet Drain

Engineer's Opinion of Probable Cost

Alternative 4 - Detention (Pond / Underground Storage)

Item	Unit	Quantity	Unit Cost	Cost
Direct Costs Incl. Escalation				**$ 20,165,320**
Construction				
Contingency@50%	LS	1	$ 10,082,660	$ 10,082,660
Mobilization/Demobilization @10%	LS	1	$ 2,016,532	$ 2,016,532
MOT @10%	LS	1	$ 2,016,532	$ 2,016,532
Construction Oversight & Inspection @10%	LS	1	$ 2,016,532	$ 2,016,532
Field Office @ 1%	LS	1	$ 201,653	$ 201,653
Construction Staging Area @1%	LS	1	$ 201,653	$ 201,653
Survey & Layout @2%	LS	1	$ 403,306	$ 403,306
Erosion & Sediment Control @3%	LS	1	$ 604,960	$ 604,960
Temporary Bypass and Dewatering for Construction - Assumed 2 Years of Dewatering	DAYS	730	$ 2,000	$ 1,460,000
Temporary Utilities - Allowance	LS	1	$ 500,000	$ 500,000
Construction Site Security	LS	1	$ 50,000	$ 50,000
				$ 39,719,149

APPENDIX E

PRELIMINARY ASSESSMENT

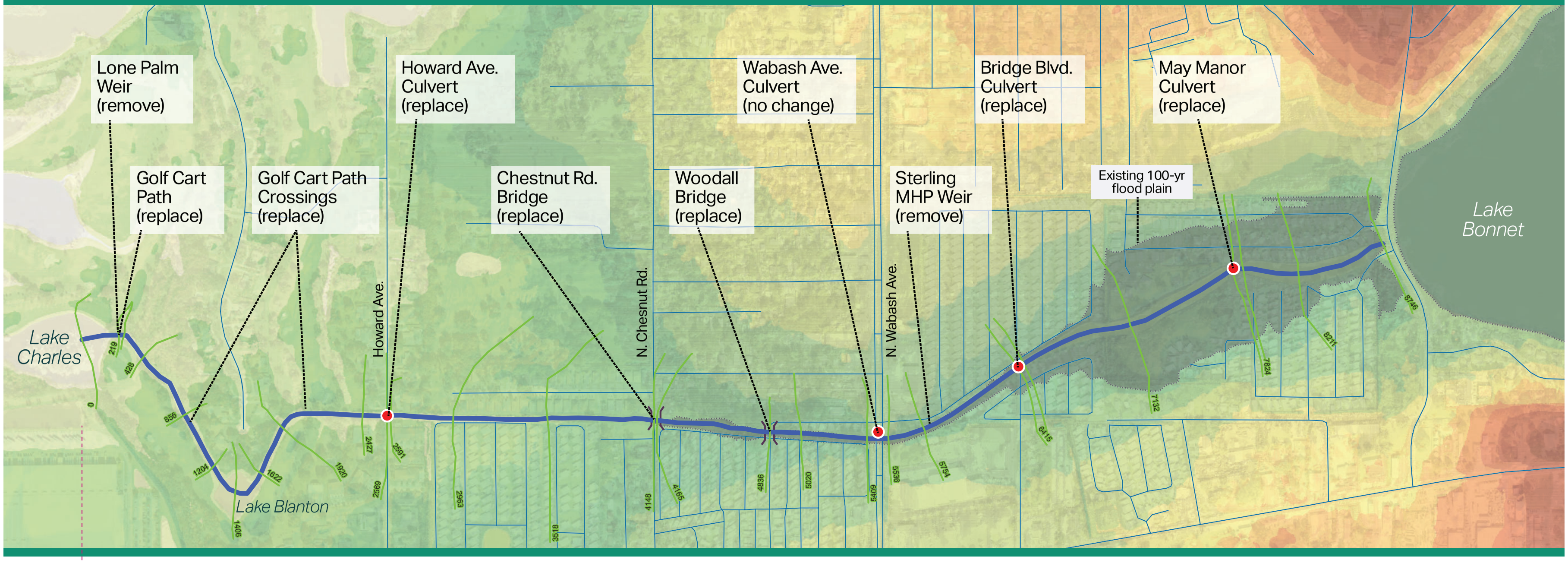
APPENDIX E1

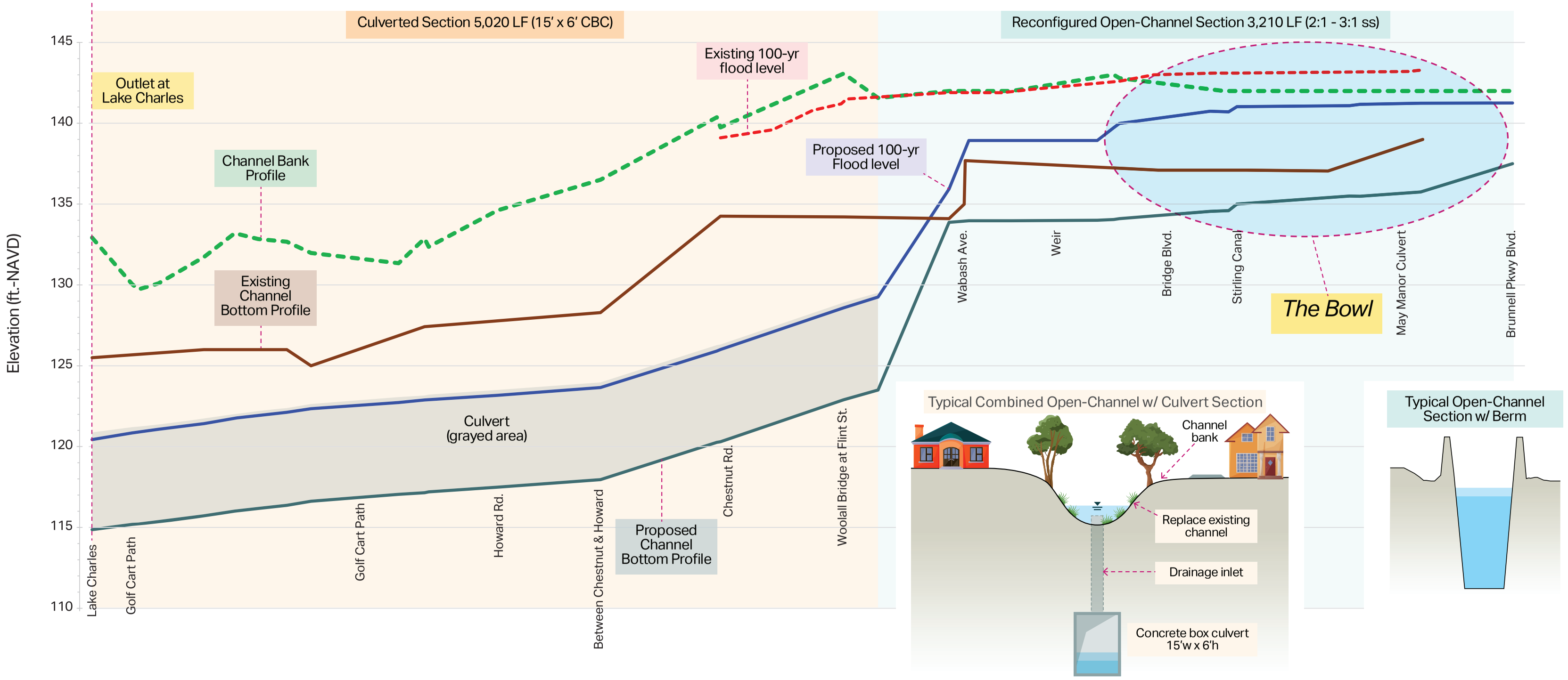
Figure 4A - Preliminary Assessment Culvert System Plan and Profile

FIGURE 4A

Lake Bonnet - May Manor Flood Mitigation Project

AECOM





APPENDIX E2

Figure 4B - Preliminary Assessment Engineer’s Opinion of Probable Cost

Lake Bonnet Drain
Engineer's Opinion of Probable Cost
Preliminary Assessment

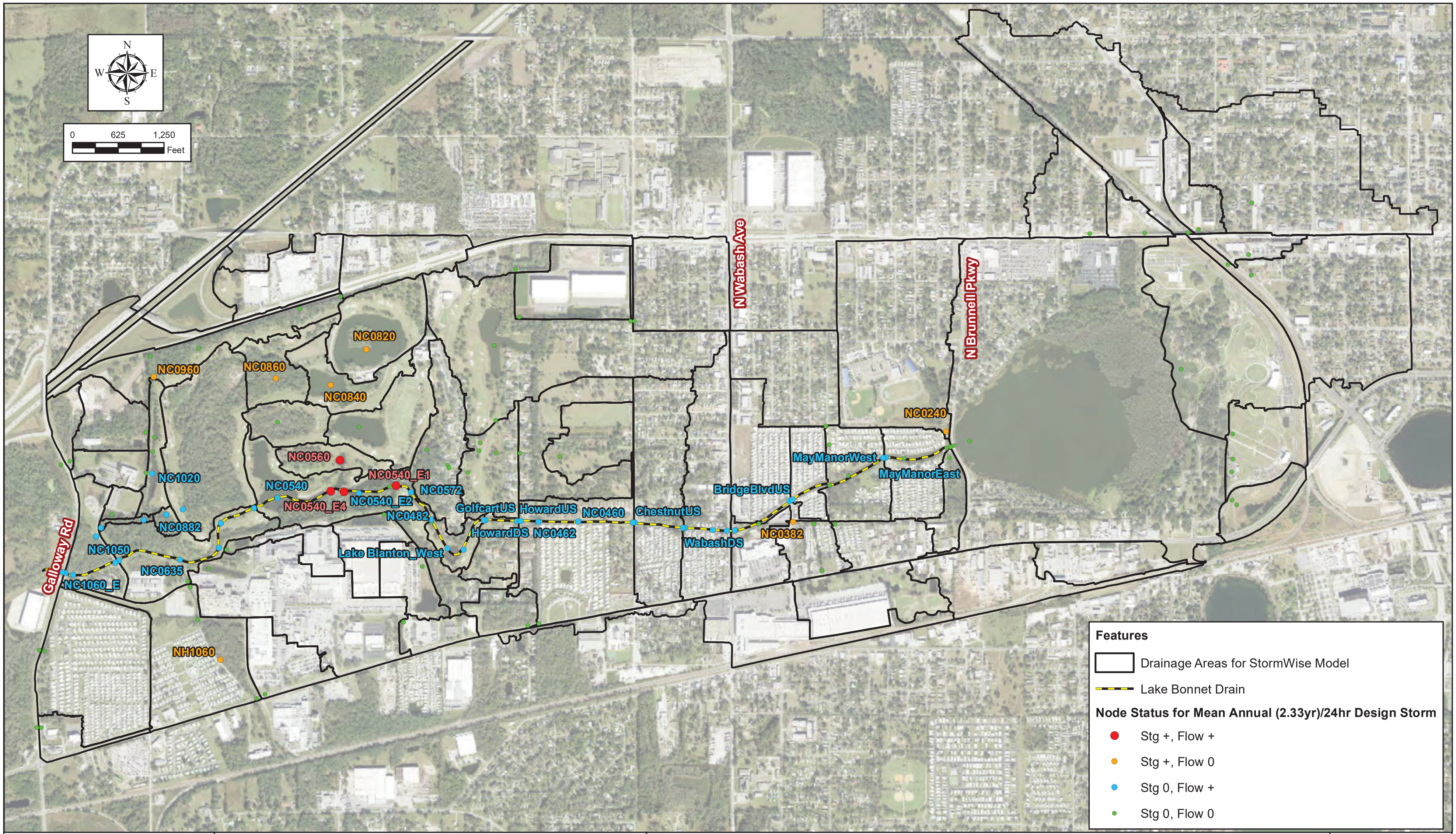
Item	Unit	Quantity	Unit Cost	Cost
Earthwork:				
Hydroseeding	SY	45,000	$ 3	$ 151,200
6" Topsoil	SY	19,000	$ 9	$ 170,240
Structural:				
Modify Lake Bonnet outlet control structure to open from top instead of bottom	EA	1	$ 183,312	$ 183,312
Reconstruct Sterling Weir (15ft Length)	EA	1	$ 183,312	$ 183,312
Culvert Box - Excavation (Assuming 15ft deep)	CY	34,861	$ 26	$ 901,857
Culvert Box - 6x15' Culvert Box Material	LF	5,020	$ 1,800	$ 9,036,000
Culvert Box - 6x15' Culvert Box Installation	LF	5,020	$ 250	$ 1,255,000
Culvert Box - Backfill and Compactation	CY	10,709	$ 6	$ 65,541
Culvert Box - Material Haul Off	CY	21,474	$ 12	$ 266,713
Culvert Box - Drainage Inlet (Assuming One every 200ft)	EA	25	$ 7,500	$ 187,500
Culvert Box - Sheet Pile Install and Abandon in Place (Assuming 22ft deep)	SF	220,880	$ 22	$ 4,958,756
Culvert Box - Subgrade Preparation Slab (12" of Gravel Base)	SY	5,578	$ 75	$ 418,333
Culvert Box - Wellpoints Installation, Removal & Miantenance	LF	10,040	$ 50	$ 502,000
Golf Lakes Dredging				
Mobilization	LS	1	$ 35,000	$ 35,000
Sediment Removal	CY	95,000	$ 25	$ 2,375,000
Sediment Haul Off	CY	95,000	$ 18	$ 1,710,000
Site Restoration	LS	1	$ 17,500	$ 17,500
Existing Culvert Bridge Scructures Replacement				
Woodall Bridge Demolition	SF	1,800	$ 9	$ 15,300
Woodall Bridge Re-build	SF	1,800	$ 200	$ 360,000
Chestnut Rd.Bridge Demolition	SF	1,800	$ 9	$ 15,300
Chestnut Rd.Bridge Re-build	SF	1,800	$ 200	$ 360,000
Howard Ave Bridge Demolition	SF	1,800	$ 9	$ 15,300
Howard Ave Bridge Re-build	SF	1,800	$ 200	$ 360,000
Golf Cart Path Crossings Demolition	SF	585	$ 9	$ 4,973
Golf Cart Path Crossings Re-built	SF	1,800	$ 200	$ 360,000
Gold Cart Path Demolition	SF	585	$ 9	$ 4,973
Gold Cart Path Re-built	LS	1,800	$ 200	$ 360,000
Utility Relocation	LS	5	$ 100,000	$ 500,000
Sterling Canal Extension				
58" H x 91" W Elliptical Class V RCP	LF	425	$ 718	$ 305,006
10'W x 6'L x 8'D Cast-in-Place Transition Box from Existing 42" HDPE to Proposed 58" x 91" Elliptical RCP	Each	1	$ 6,144	$ 6,144
Outlet Headwall for 58" x 91" Elliptical RCP	Each	1	$ 22,729	$ 22,729
72" Tideflex Series 37G Inline Check Valve at Outlet Headwall	Each	1	$ 13,103	$ 13,103
Demolition				
Remove Sterling Weir (25CY Assumed)	LS	1	$ 3,777	$ 3,777
Land Acquisition (Allowance)				
Temporary easement for construction	LS	1	$ 600,000	$ 600,000
Permanent easement for maintenance and operation	LS	1	$ 100,000	$ 100,000
Subtotal				**$ 25,823,867**
Escalation @ 5.6% annually to MOC				$ 2,892,273
Direct Costs Incl. Escalation				**$ 28,716,140**

Lake Bonnet Drain
Engineer's Opinion of Probable Cost
Preliminary Assessment

Item	Unit	Quantity	Unit Cost	Cost
Construction				
Contingency@50%	LS	1	$ 14,358,070	$ 14,358,070
Mobilization/Demobilization @10%	LS	1	$ 2,871,614	$ 2,871,614
MOT @10%	LS	1	$ 2,871,614	$ 2,871,614
Construction Oversight & Inspection @10%	LS	1	$ 2,871,614	$ 2,871,614
Field Office @ 1%	LS	1	$ 287,161	$ 287,161
Construction Staging Area @1%	LS	1	$ 287,161	$ 287,161
Survey & Layout @2%	LS	1	$ 574,323	$ 574,323
Erosion & Sediment Control @3%	LS	1	$ 861,484	$ 861,484
Temporary Bypass and Dewatering for Construction - Assumed 2 Years of Dewatering	DAYS	730	$ 2,000	$ 1,460,000
Temporary Utilities - Allowance	LS	1	$ 500,000	$ 500,000
Construction Site Security	LS	1	$ 50,000	$ 50,000
				$ 55,709,182

APPENDIX E3

Mean Annual (2.33-Year) / 24-Hour Offsite Impacts For Preliminary Assessment



AECOM

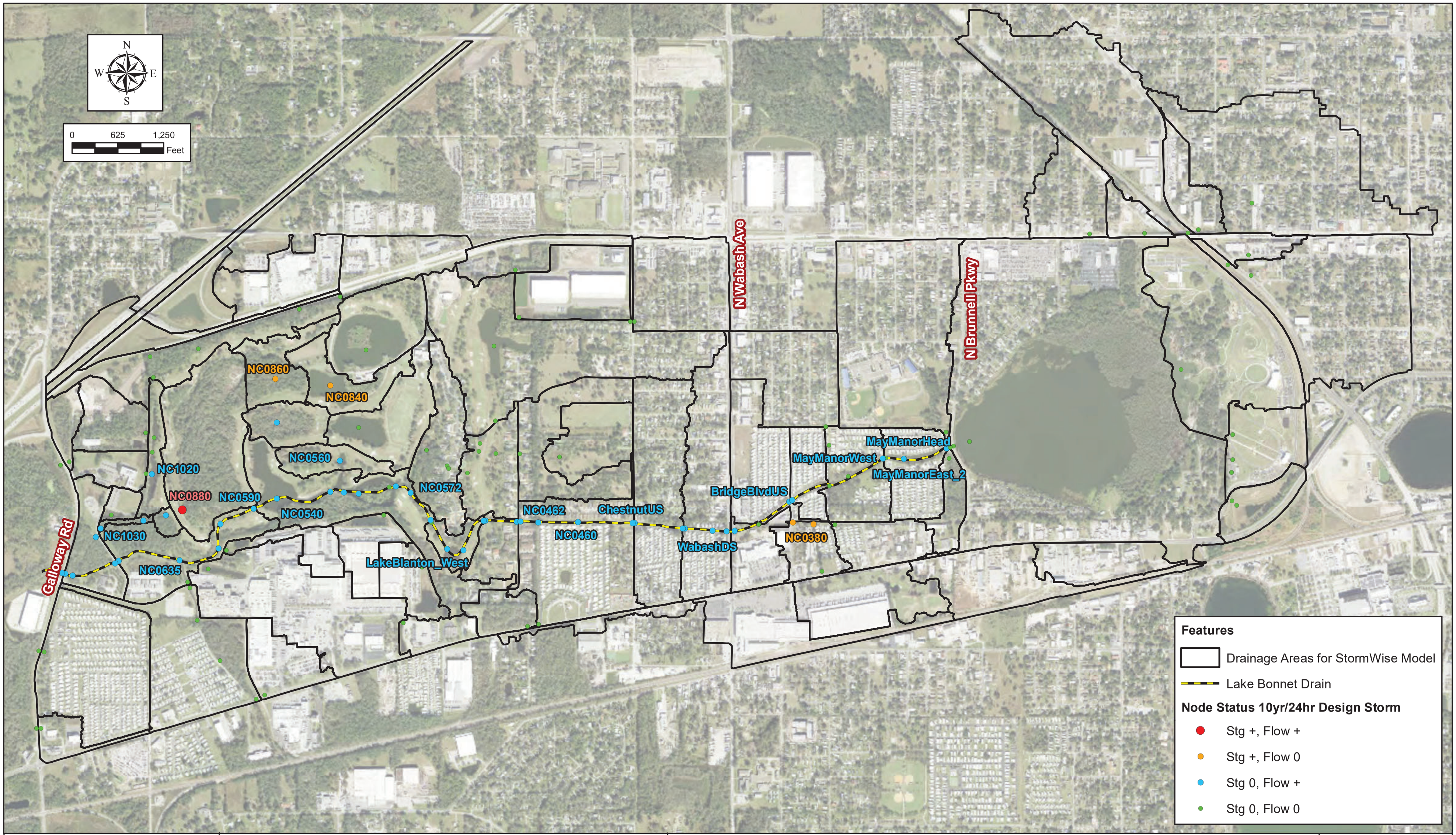
NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
MEAN ANNUAL (2.33-YEAR) / 24-HOUR OFFSITE IMPACTS FOR PRELIMINARY ASSESSMENT

FIGURE
4C

APPENDIX E4

10-Year / 24-Hour Offsite Impacts For Preliminary Assessment



AECOM

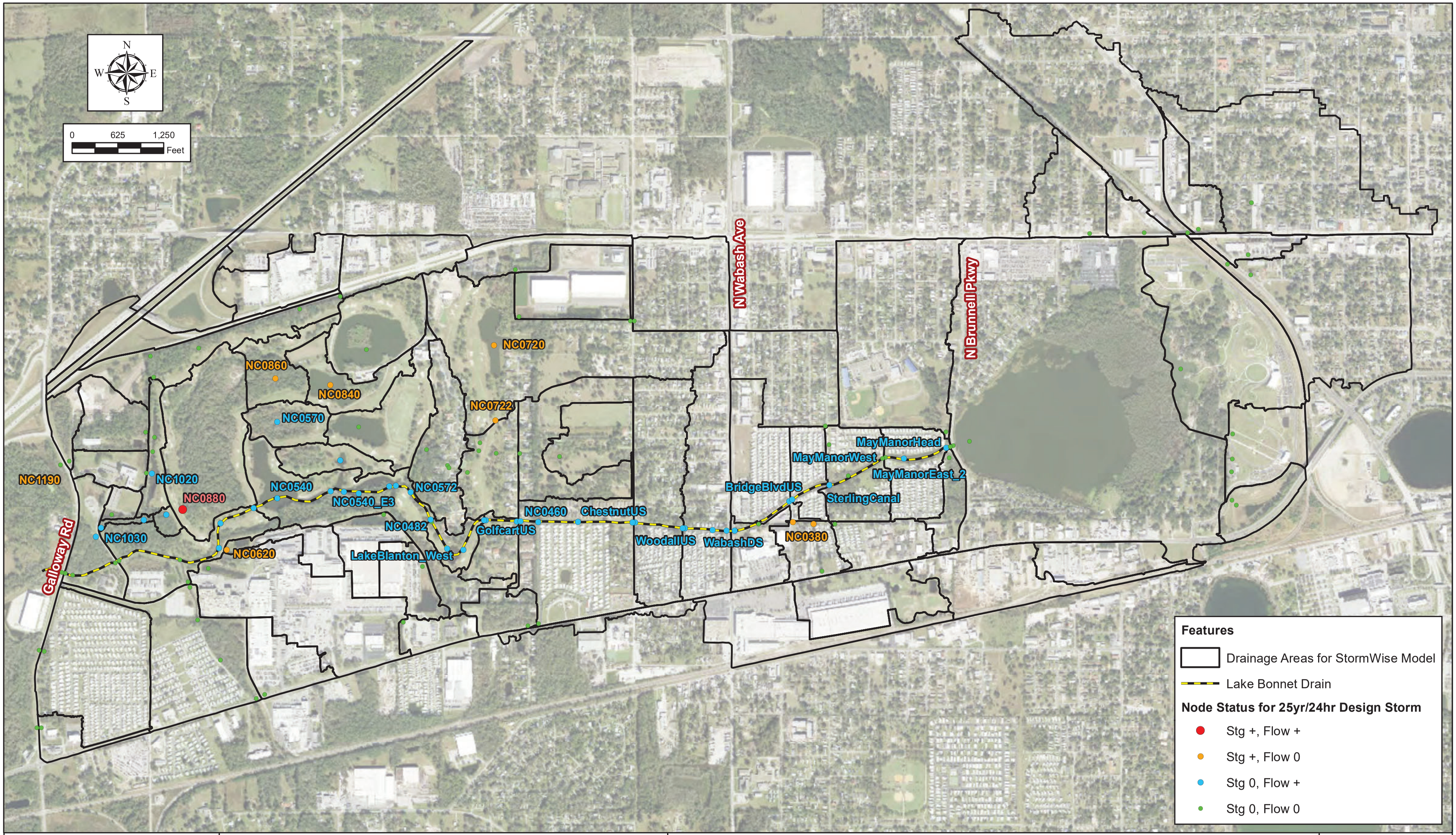
NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
10-YEAR / 24-HOUR OFFSITE IMPACTS FOR PRELIMINARY ASSESSMENT

FIGURE
4D

APPENDIX E5

25-Year / 24-Hour Offsite Impacts For Preliminary Assessment



AECOM

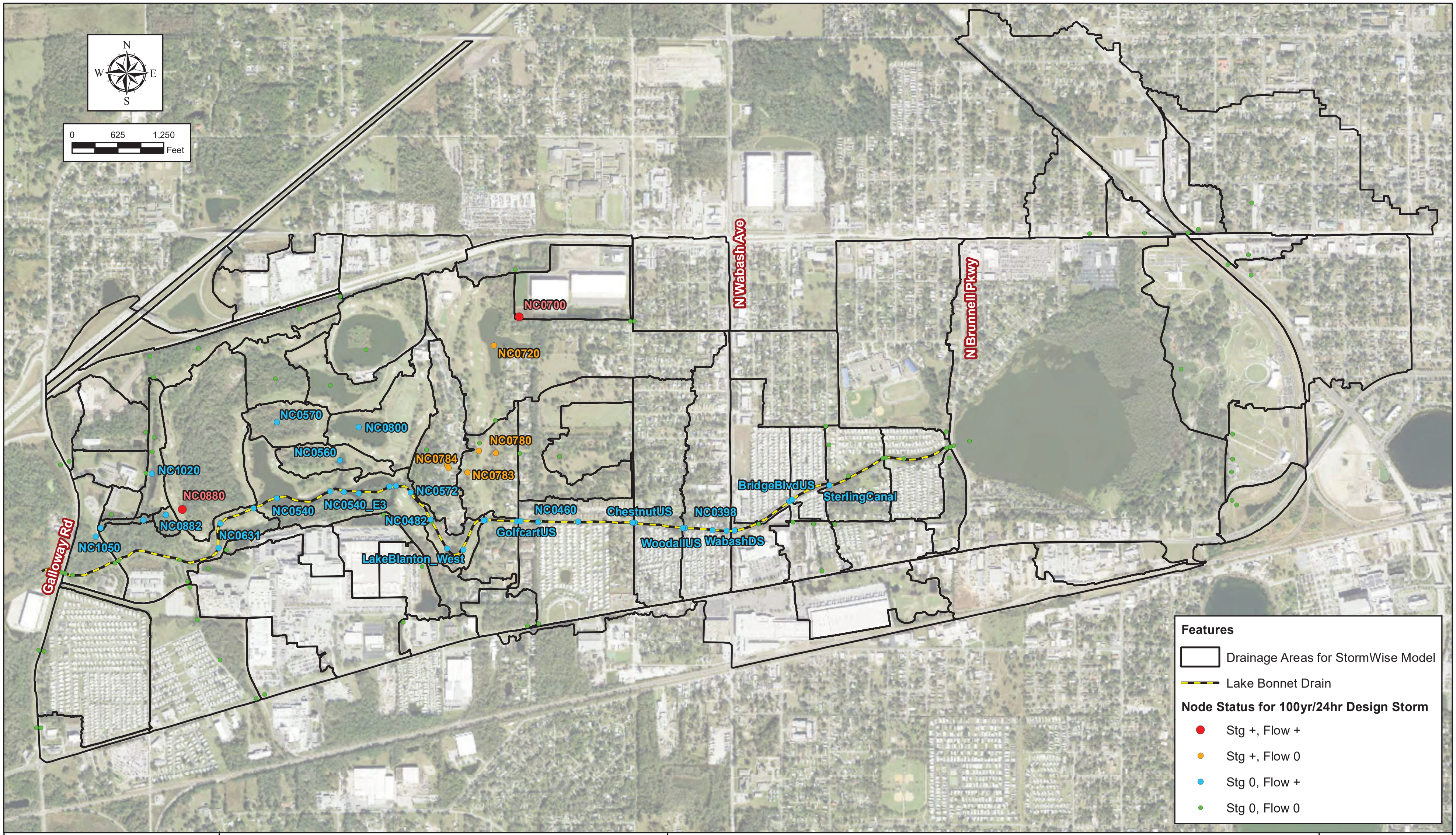
NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
25-YEAR / 24-HOUR OFFSITE IMPACTS FOR PRELIMINARY ASSESSMENT

FIGURE
4E

APPENDIX E6

100-Year / 24-Hour Offsite Impacts For Preliminary Assessment



AECOM

NOTE: 'Node Status' is an indication of a change in peak flood elevation and/or peak flow rate, comparing Existing Conditions to an Alternative Condition at each nodal location.

LAKE BONNET DRAIN FLOOD HAZARD MITIGATION PROJECT
CITY OF LAKELAND
100-YEAR / 24-HOUR OFFSITE IMPACTS FOR PRELIMINARY ASSESSMENT

FIGURE
4F

Appendix F

Stormwise Model Input Documentation for Lake Bonnet Drain Floodplain Mitigation Feasibility Study

(The Appendix is provided under a separate document due to the large file size)

The information contained in the Figures and various Appendices below consists of plan views of the model schematics (basins, nodes, links, etc.) and comprehensive model input documentation representing existing conditions and proposed conditions for each of the floodplain mitigation alternatives.

♦ ♦ ♦

APPENDIX G

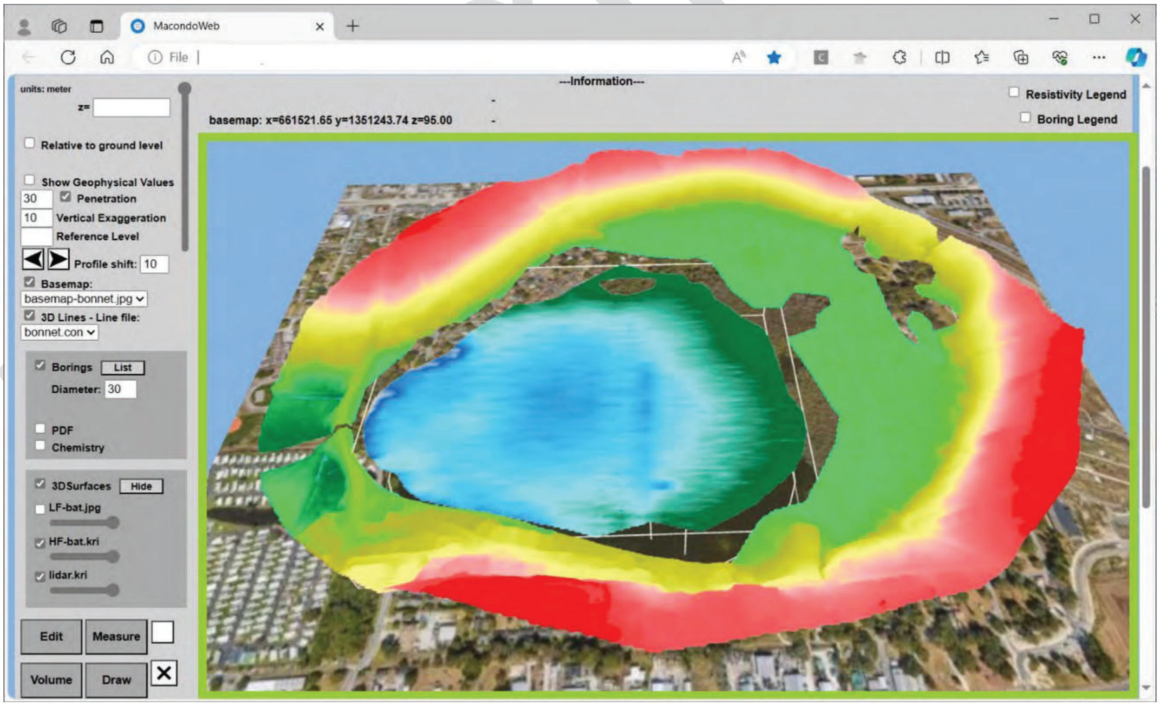
HYDROGRAPHIC AND GEOPHYSICAL SURVEY REPORTS

City of Lakeland - Lake Bonnet
Drainage Basin Flood Hazard & Debris Mitigation Project
AECOM Project Number - 60721840

Hydrographic and Geophysical Survey Report

Prepared for:

AECOM Technical Services, Inc.
110 East Broward Blvd., Suite 700
Fort Lauderdale, FL 33301
Attn: Babu S. Madabhushi
Email: babu.madabhushi@aecom.com
Mobile: (305) 439-0869



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☑ HF-bat.kri
☑ lidar.kri

---Information---

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☐ Resistivity Legend
☐ Boring Legend

May 2024

Lake Bonnet Drainage Basin
Flood Hazard & Debris Mitigation Project

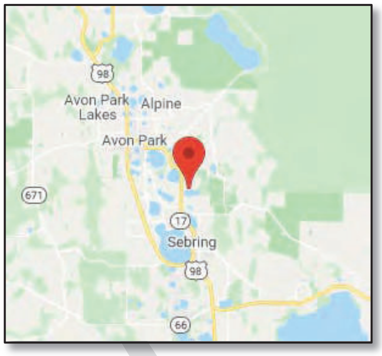
Integrated Digital Geological Model

Report :	R240506a-LakeBonnet May 2024 Lake Bonnet IDGM
Surveyor:	Arc Surveying & Mapping, Inc. 5202 San Juan Avenue Jacksonville, Florida 32210 USA Email : jsawyer@arcsurveyors.com
Survey Dates :	Hydrographic Survey March 10 & 11, 2024 Geophysical May 1, 2024

Contents

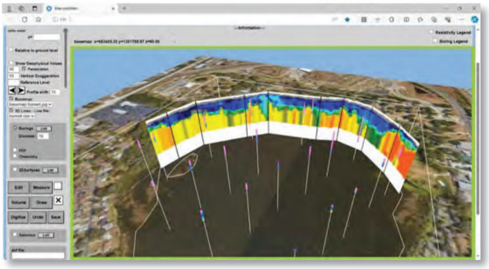
Figures

1. *Introduction*



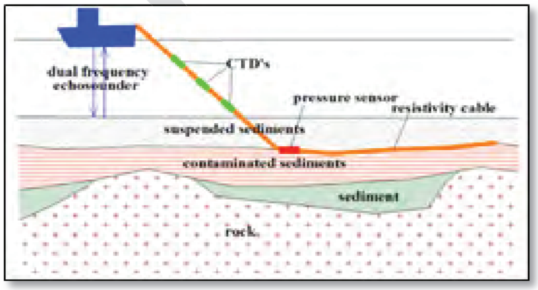
Arc Surveying & Mapping, Inc. (Arc) of Jacksonville, Florida was contracted by AECOM Environmental Services, Inc. (AECOM) to perform a hydrographic and geophysical survey of Lake Bonnet, located in Lakeland, Polk County, Florida within the Hillsborough River Watershed.

The purpose of the survey is to provide, AECOM, a professional engineering and environmental consultant, with high accuracy surveys that will assist the City of Lakeland with planning, design and the restoration of Lake Bonnet. The project consists of wetland restoration, lake bottom sediment dredging (to resolve contaminated muck issue) and the development of flood mitigation infrastructure to reduce flood risk.



Previous project investigations offer that Lake Bonnet has a water surface area of 79 +/- acres, a perimeter of 7,381 ft., a water surface elevation of 144.0 ft. North American Vertical Datum of 1988 (NAVD88), an average depth of 3 ft. with a maximum depth of 13 ft. According to various investigative studies, a substantial quantity of contaminated organic sediment (muck) covers some of the lake bottom at thicknesses ranging from 0.5 ft. to15 ft. The thickest deposits of muck lie along the northeast and southeast boundaries of the lake and indicate a thickness of up to 24 ft. The location and thicknesses of muck have been determined by a variety of methods including probes, piston tube and vibracore sample recovery. Previous sampling methods, while describing subsurface conditions at each point of sampling, do not identify the full extent of existing conditions nor the actual extent or limits of muck infiltration. It is anticipated that the bathymetric and geophysical data contained in this report and the project ArcGeoTwin 3D Interactive Digital Geological Model fully describes existing conditions in precise detail providing AECOM with a variety of remediation design options.

2. *Methods & Survey Notes*



This survey was accomplished by towing a 200 ft. long, 1" diameter multichannel cable on the bottom surface of Lake Bonnet. Dual frequency sonar depth soundings and electrical resistivity sub-bottom geophysical data were acquired simultaneously at 50 ft. line spacing over the entire navigable area of the lake. Dual frequency sonar data (200/24 kHz) identified the presence of suspended sediments (fluff), while resistivity data identified subsurface geological structures below suspended sediments to a depth of approximately 35 ft.

1. The investigative single beam dual frequency depth sounding survey was performed on 11 March 2024. (see attached drawings).
2. The geophysical survey was performed on 1 May 2024. The Lake water level was 143.9 ft (NAVD88).
3. Soundings are in feet and tenths and refer to North American Vertical Datum of 1988 (NAVD88).
4. Plane Coordinates are based on the Florida West State Plane Zone, North American Datum of 1983 (NAD83).
5. This survey was performed using the Trimble RTK base station referenced to onsite NGS control.
6. Soundings were acquired utilizing a Teledyne E20 dual frequency single beam sounder operating at 200/24 kHz.
7. Geophysical data were acquired utilizing an Aquares/Demco NV resistivity system. A multichannel cable was towed on the seabed capable of penetrating depths of 35 +/- ft. below the seabed.
8. Standard field calibrations for all equipment were performed, resulting accuracy was within manufacturer’s specifications.

2.1. Land Based Applications

An electrical current is injected into the subsurface by means of two current electrodes. The voltage gradient associated with the electrical field of this current is measured between two voltage electrodes placed in between the current electrodes (see fig. 1). Based on the measured values of current and voltage the average resistivity of the subsurface is calculated for a subsurface volume down to a certain penetration depth. The penetration depth depends on the distance between the current electrodes. Larger electrode distances are associated with increasing penetration depths.

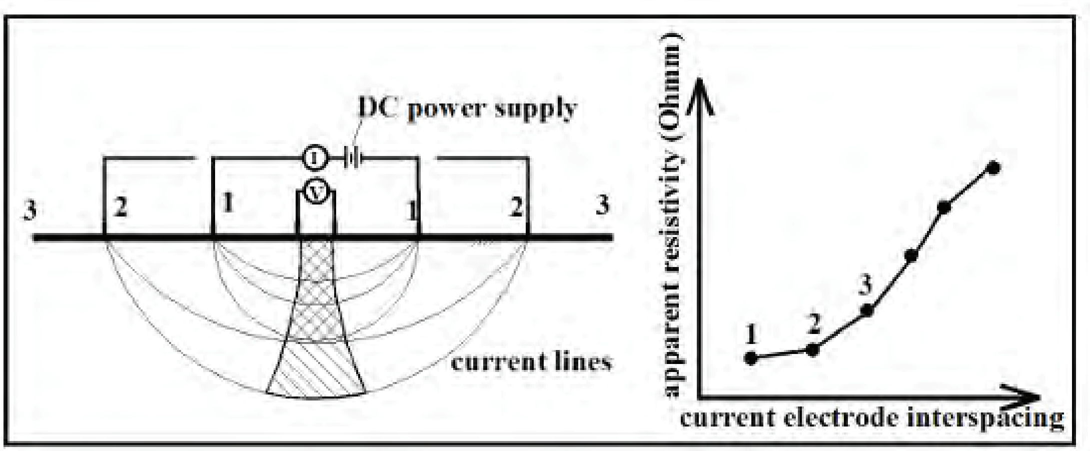


Figure 1: Principles of Vertical Electrical Sounding

If the measurements are repeated with progressively increasing current electrode distances, information is obtained from progressively deeper geological structures (fig. 1). As such, a field curve is obtained showing the resistivity as a function of the (horizontal) distance between the current electrodes. After computer modeling, the field curve is transformed into a real geophysical subsurface section showing the resistivity as a function of depth.

The resistivity of a geological structure depends on its porosity, water saturation and the pore water conductivity. Sand can be expected to show higher resistivity values as compared to silt. Soft clay generally shows low resistivity values while stiff clay is marked by high resistivity values. Cemented sediments show higher resistivity values as compared to soft sediments. Thus, every geological structure has its own specific resistivity value.

2.2. *Fluvial and Marine Applications*

For water-based applications the electrodes are placed on a multichannel cable trailing behind the survey vessel (fig. 2). The electrode geometry is chosen such that good quality data may be obtained even for shallower targets.

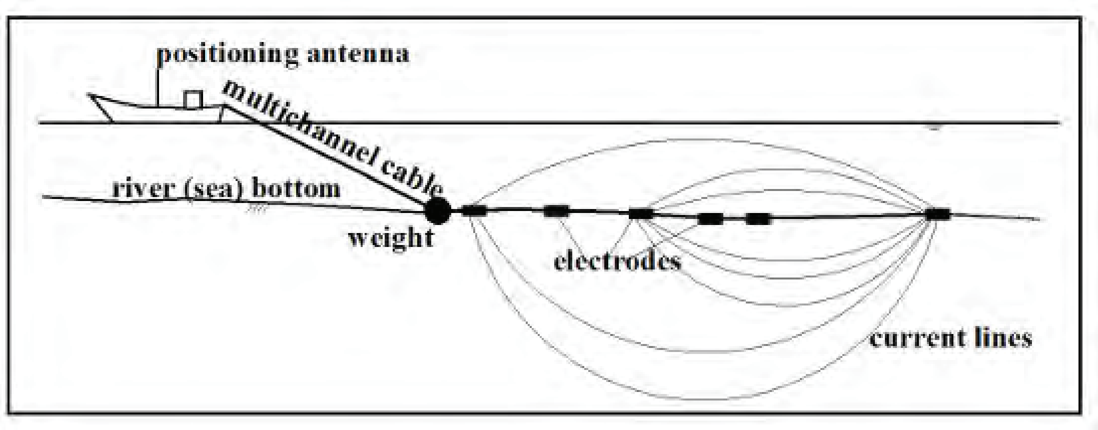


Figure 2: Marine/Fluvial applications

While the survey vessel is sailing the measurements are carried out and stored automatically without any intervention from the operator. As such, an entire electrical sounding may be obtained every one second. At a boat speed of two m/s this corresponds to a horizontal resolution of one sounding every two meters.

The time of measurement is stored with each single resistivity measurement. This gives the opportunity to synchronize the resistivity data with the positioning data and tidal information.

During the field survey qualitative results are shown on the computer screen. The quality of the field data is monitored online so the operator can intervene at any moment to adjust and optimize the survey parameters.

2.3. *Data Processing and Interpretation*

A complex sequence of mathematical operations must be followed before interpretable results are obtained.

First, the resistivity field data are edited and filtered to increase the signal/noise ratio. The bathymetric and positioning data are edited as well. Then, the resistivity data, positioning data and bathymetric data are combined.

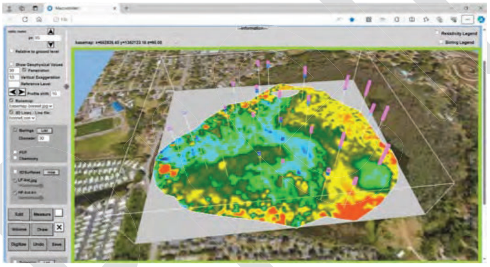
Geometrical corrections are applied to correct for the fact that the sailed line (and the cable as well) may show more or less significant curvatures. Measurements made with a strongly curved cable are rejected. In case of a bottom towed cable other corrections are made to account for the water depth. A correct water correction requires homogeneous vertical water column resistivities or a detailed knowledge of vertical resistivity layering in the water column.

An important phase in the processing sequence is the resistivity data inversion. In this step the apparent resistivity data is transformed into a vertical section of the subsurface showing depths and thicknesses of each geological structure.

The resistivity information is interpolated into a regular grid either on a cross-section or in two dimensions. Each interpolated grid point represents a complete geological profile of the subsurface showing the resistivity as a function of depth. The results are visualized in color on cross sections showing the different geological structures in function of depth and geographical position. The results can be interpreted using information from a limited number of well-chosen borehole locations targeting each of the structures identified.

The processing procedure described above is an interactive process. In order to extract maximum information out of the raw survey data the processing sequence has to be repeated several times to find the optimum processing parameters.

3. *ArcGeoTwin 3D Modeling Data*



Hydrographic and geophysical georeferenced survey data were acquired at 50 ft. line spacing. Hydrographic and geophysical survey profile lines were converted to a digital terrain model (DTM). Vibracore borings dated 2018 (provided by AECOM) were incorporated into the model. Lidar data describing ground surface elevation around the perimeter of Lake Bonnet were provided by AECOM and incorporated into the ArcGeoTwin 3D project model.

4. *Survey Results*

The IDGM (Integrated Digital Geological Model) is available and accessible on the Arc Surveying & Mapping server in Jacksonville using the ArcGeoTwin platform. Access is provide using a username and password aft.er pressing the “Launch ArcGeoTwin” button on the following link: https://www.arcsurveyors.com/geotwin/. The ArcGeoTwin 3D model of Lake Bonnet is available 24/7 for the life of the project.

4.1. *Bathymetry*

Figure 3a shows the low frequency bathymetry while figure 3b shows the high frequency bathymetry as acquired during the Aquares survey.

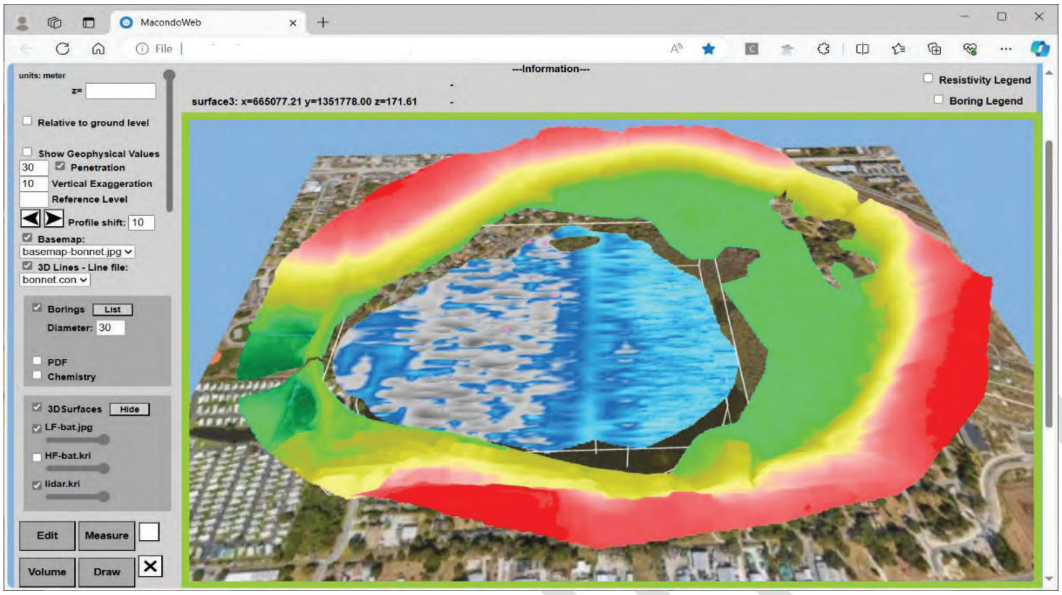


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Figure 3a: ArcGeoTwin – Low Frequency bathymetry and lidar information

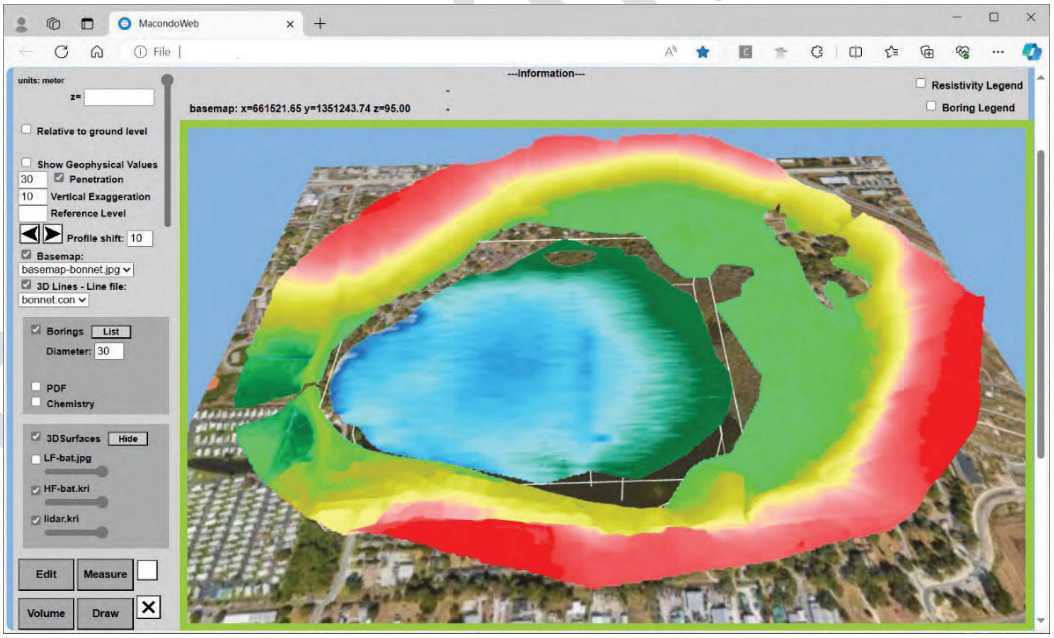

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Figure 3b: ArcGeoTwin – High Frequency bathymetry and lidar information

Substantial differences up to 4 to 6 ft. are found between the high and low frequency bathymetric information. The most significant differences are found in the western area.

4.2. *Aquares Vertical Sections*

The vertical geophysical sections of Figure 4a, b and c show a vertical exaggeration of 10x with gray and blue colors for the lowest resistivity values, orange-yellow-green for high resistivity values and light-blue colors for intermediate resistivity values. The geophysical sections have been referenced to low frequency bathymetric levels. High frequency levels are represented by the black line higher up in the vertical sections.

The east-west section of figure 4a shows low resistivity structures at the surface representing relatively thick muck deposits in the east and thinner deposits in the western reaches. In the eastern reaches the muck deposits. The high resistivity structures (green) underlying the muck in the eastern area correlates with sand and silty sand as described in the borings while the intermediate resistivity values (light blue) in the western area correlates with fat clay. In the central area high resistivity structures (green) underly the fat clay deposits. As these deeper structures have not be samples by the borings, we don't know their true nature. The high resistivity structures (green-yellow) on top of the fat clay in the western reaches correlates with sand in the borings.

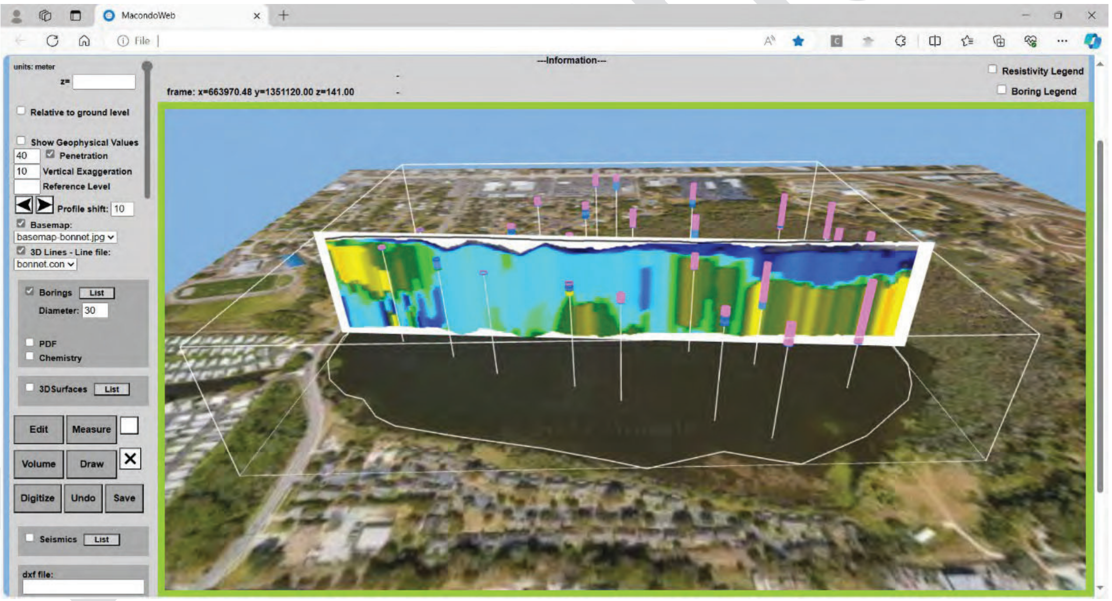

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Figure 4a: East-West vertical geophysical section

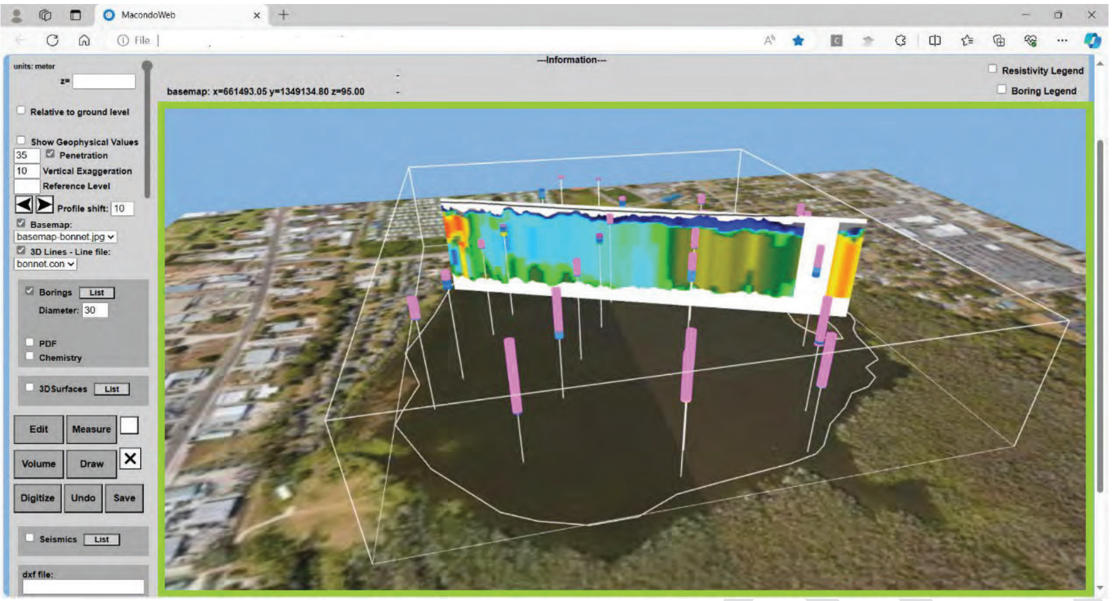

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Figure 4b: North-South vertical geophysical section - West

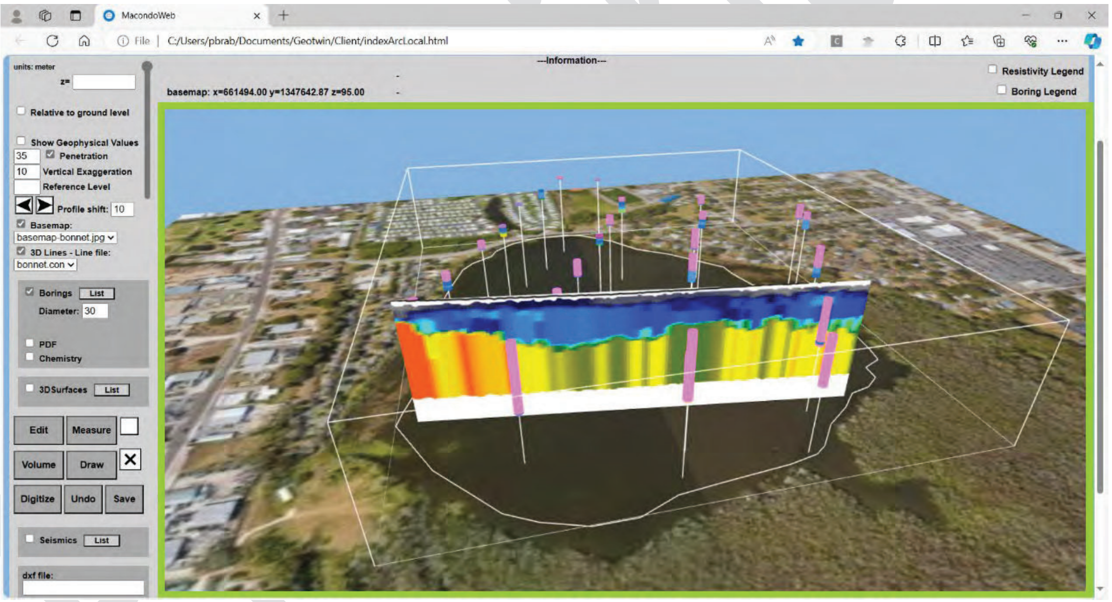

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Figure 4c: North-South vertical geophysical section - East

This north-south oriented vertical section of figure 4b shows for the southern reaches the same fat clay and deeper high resistivity structures as described for the western reaches of figure 4a and much shallower high resistivity structures in the northern reaches correlating with sand and silty sand as described for the eastern reaches of figure 4a.

The North-South oriented vertical section of figure 4c shows the thick muck deposits of the eastern area resting on top high resistivity sand deposits.

Figure 4d shows the muck thicknesses along the cedar forest limits in the eastern basin.

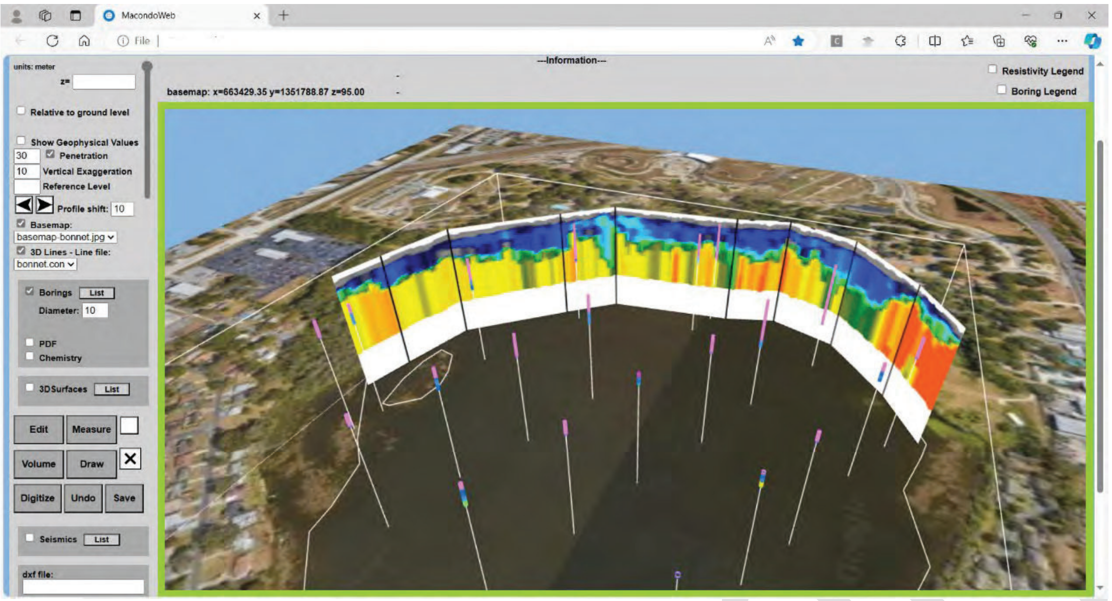

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Figure 4d: Geophysical profile along the cedar forest

4.3. Horizontal Resistivity Sections

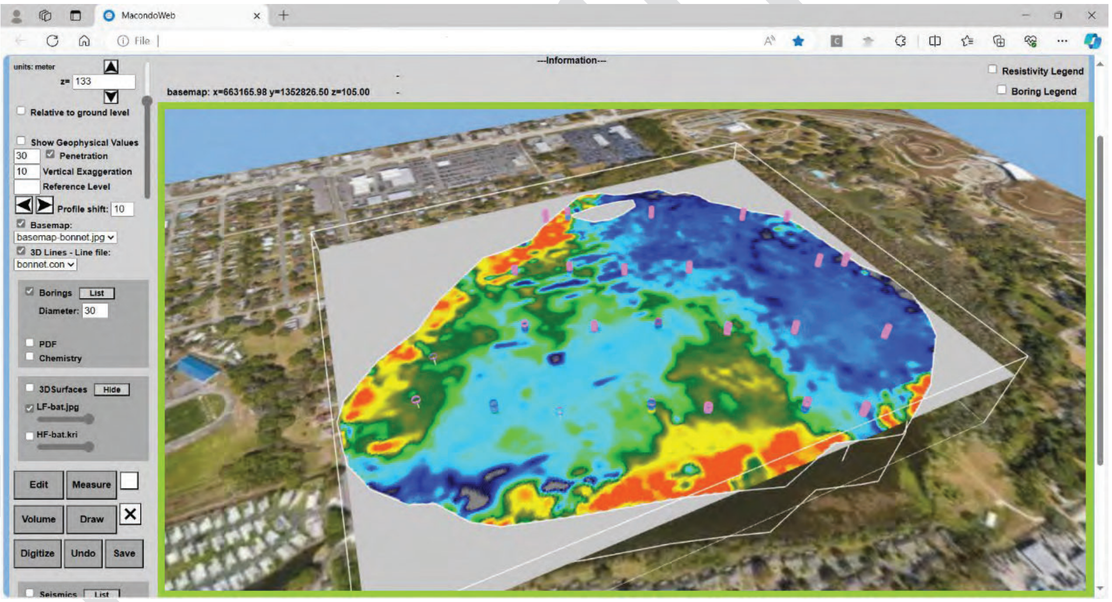

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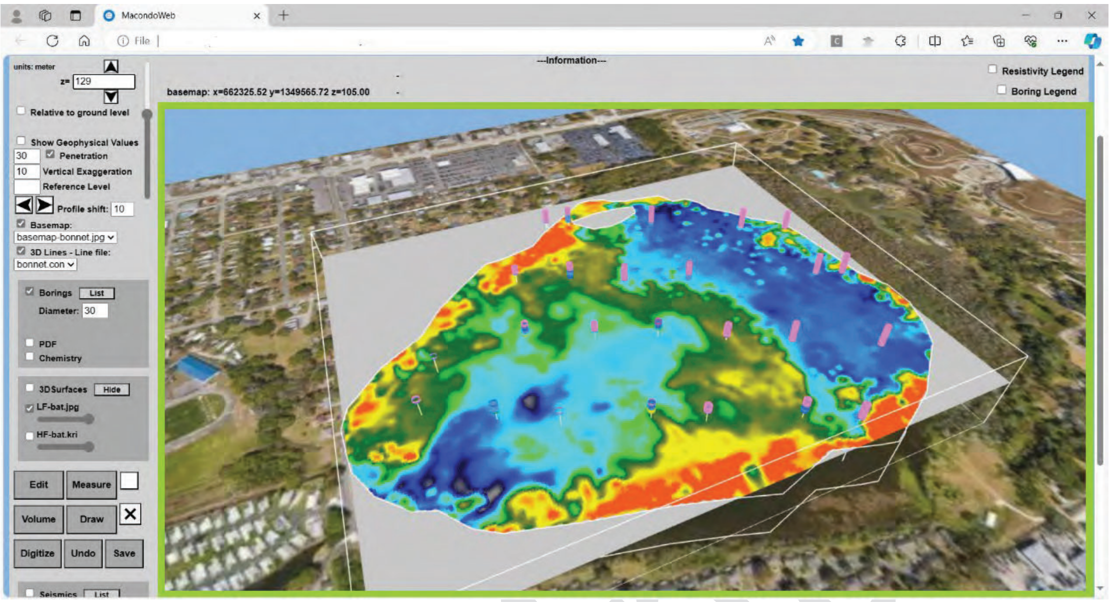
Figure 5a: ArcGeoTwin - Horizontal geophysical section at 133 feet Chart Datum

Figure 5a, b, c and d show horizontal resistivity sections at 133, 129, 120 and 95 feet respectively.

Figure 5a shows a shallow horizontal section at 133 feet above chart datum with the low resistivity (blue) muck deposits in the eastern area and intermediate resistivity fat clay deposits (light blue) in the western basin surrounded by sand deposits along the lake shores and a sandy ridge separating it from the western basin.

Figure 5b at 129 feet above chart datum shows the same sandy ridge, more pronounced, separating the two sediment basins.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☐ Boring Legend

Figure 5b: ArcGeoTwin - Horizontal geophysical section at 129 feet Chart Datum

The horizontal section at 120 feet above chart datum of figure 5c shows the deepest remains of the eastern basin (light blue-light green) most likely representing more consolidated muck.

The horizontal section at 95 feet shows an ENE trending high resistivity ridge below the fat clays of the western basin and similar high resistivity structures along the southern shoreline.

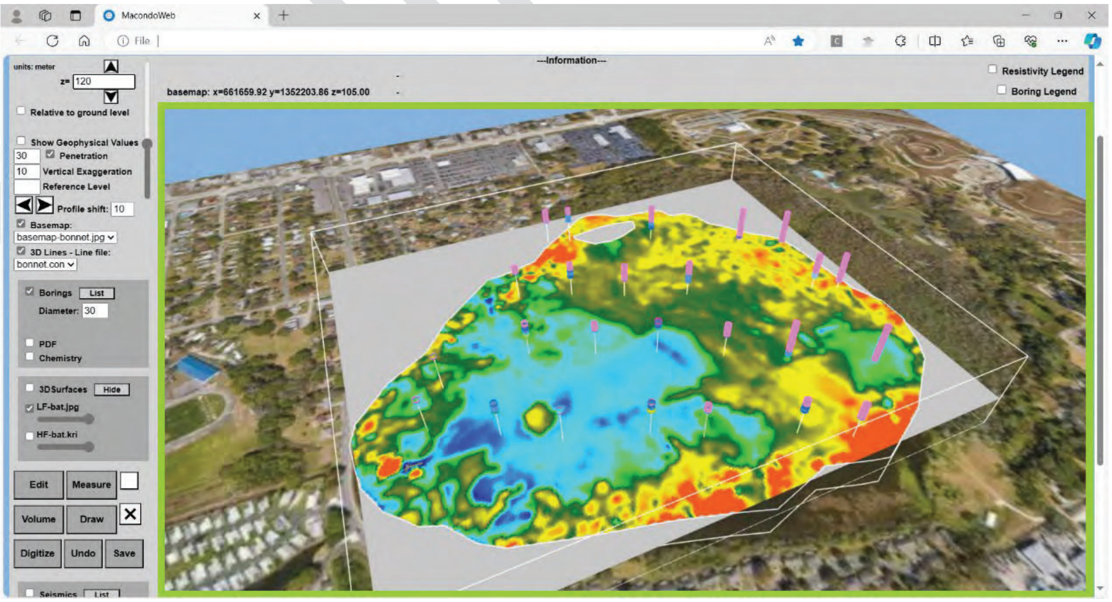
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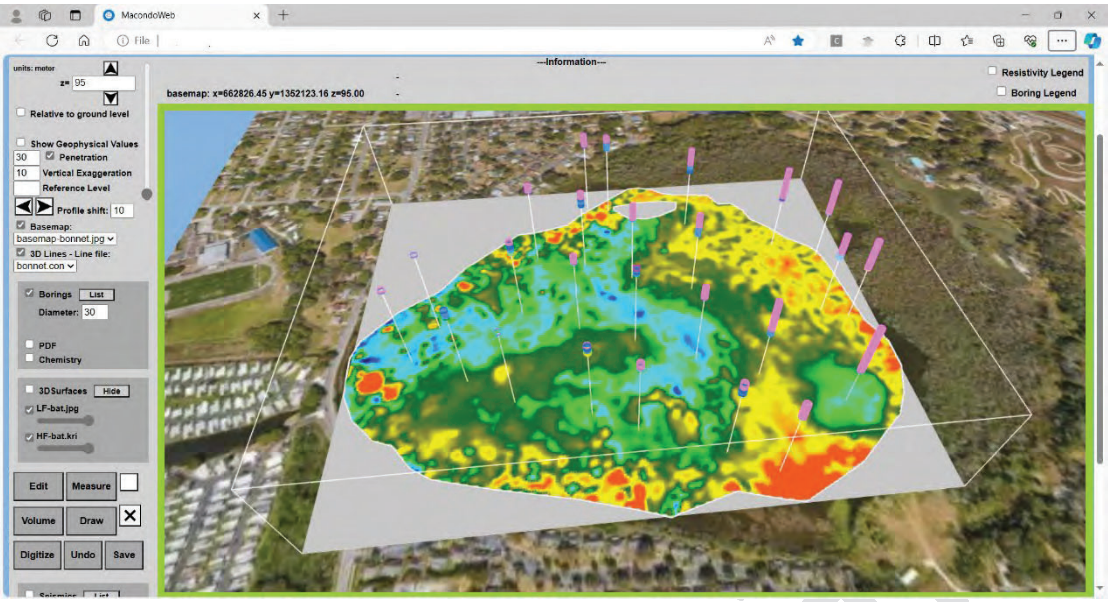
Figure 5c: ArcGeoTwin - Horizontal geophysical section at 120 feet Chart Datum



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10 Vertical Exaggeration

Reference Level

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Figure 5d: ArcGeoTwin - Horizontal geophysical section at 95 feet Chart Datum

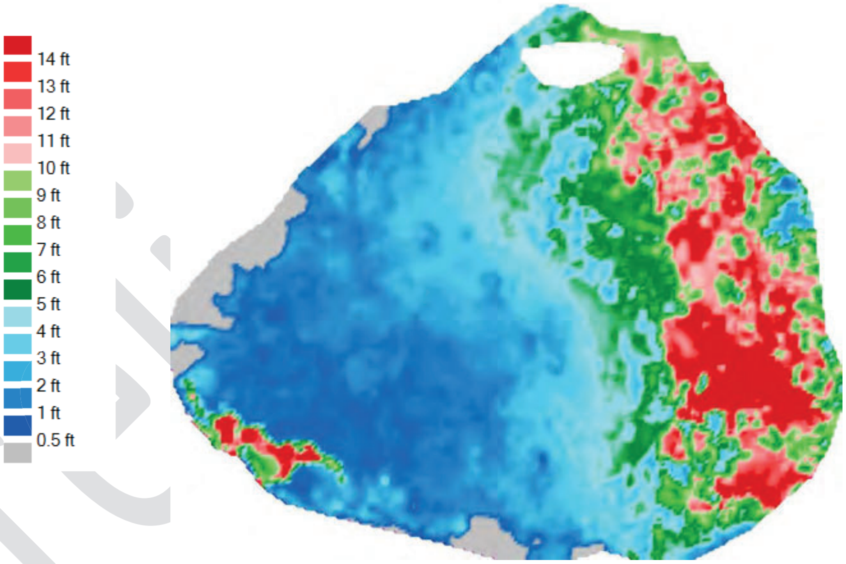

Figure 6: Thickness of Low Resistivity Layer

4.4. Muck Thickness

Figure 6 shows the thicknesses of the low resistivity surface layer (<25 Ohmm) which seems to correlate with muck as described in the borings. The total volume of low resistivity material amounts to about 655,528 yd^3.

5. Conclusions

The Aquares results suggest the existence of two (2) sediment basins in Lake Bonnet separated by a sandy ridge. The eastern basin contains relatively thick muck deposits on top of sand while the western basin contains a thinner muck deposit on top of fat clay with undefined high resistivity structures at deeper levels and sandy deposits covering the fat clay along the western shoreline.

There appears to be a good correlation with the hydrographic and geophysical survey the 2018 Vibracore boring information provided by AECOM.

If it were to be decided to remove the muck in the eastern basin and a retaining wall were to be constructed to protect the cedar forest in the eastern reaches of the lake, this retaining wall would have to penetrate between five (5) and twelve (12) feet of muck before reaching the underlying sand.

If it were to be decided to cap the muck, capping sand could be found along the shallow sandy ridge separating the western and eastern basins.

The Integrated Digital Geological Model, integrating boring information, high and low frequency bathymetric levels and Aquares information is accessible through the ArcGeoTwin platform. It clearly shows the location, extent and thickness of above-described sediment features.

Note: Arc Surveying & Mapping, Inc. and its subconsultants provide this report and attachments with the understanding that hydrographic and subsurface surveys have been performed professionally to high standards and with careful consideration regarding accuracy, jobsite conditions and safety. Standard practice precautions have been taken to assure the enclosed data meets the directions and requirements of the client.

For more information please contact:

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Project Administrator
Arc Surveying & Mapping Inc.
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Mobile: (904) 616-7039
Email: jsawyer@arcsurveyors.com

Peteralv Brabers, Ph.D., Director
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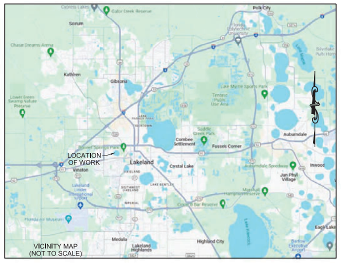
John K. Maffett, PLS, Vice-president
Project Surveyor
Arc Surveying & Mapping, Inc.
Office: (904) 384-8377
Email: jmaffett@arcsurveyors.com

Attachments: Survey Maps

End of Report

A MAP SHOWING A DUAL-FREQUENCY HYDROGRAPHIC SURVEY

OF LAKE BONNET LOCATED IN LAKELAND, POLK COUNTY, FLORIDA



SURVEYOR'S NOTES:

1. ALL DIMENSIONS, UNLESS OTHERWISE NOTED, ARE IN US SURVEY FEET.
2. HORIZONTAL DATUM IS REFERENCED TO THE FLORIDA STATE PLANE COORDINATE SYSTEM, WEST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83), BEING DERIVED UTILIZING A TRIMBLE R10 RTK BASE STATION. BASE REFERENCE POINT WAS ARC 3, A SET 1/2" IRON PIPE, HAVING COORDINATES OF E 662,627.89, N 1,349,407.21 NAD83.
3. ELEVATIONS SHOWN HEREON ARE IN US SURVEY FEET AND ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM ON 1988 (NAVD88), BEING REFERENCED TO ARC3, A SET 1/2" IRON PIPE, HAVING AN ELEVATION OF 147.18 NAVD88.
4. HYDROGRAPHIC SOUNDING MEASUREMENTS WERE MADE WITH A TELEDYNE ECHOTRAC E20 SOUNDER OPERATING AT 200KHZ (HIGH-FREQUENCY) AND 24KHZ (LOW-FREQUENCY).
5. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES LISTED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THE TIME OF ACQUISITION.
6. THE SURVEY WAS PERFORMED FROM MARCH 10 THRU MARCH 11, 2024.
7. THE ABOVE WATERS WERE SURVEYED UNDER THE RESPONSIBLE SUPERVISION AND DIRECTION OF THE SIGNING PROFESSIONAL SURVEYOR AND MAPPER. THE SURVEY SHOWN HEREON MEETS THE STANDARDS OF PRACTICE SET FORTH BY THE FLORIDA BOARD OF PROFESSIONAL SURVEYORS AND MAPPERS PURSUANT TO CHAPTER 5J-17.052 OF THE FLORIDA ADMINISTRATIVE CODES.

CONTROL TABULATION

POINT ID	NORTHING	EASTING	ELEVATION	DESCRIPTION
ARC 3	1,349,407.21	662,627.89	147.18	SET 1/2" IRON PIPE
GPS 1083 AZ MK	1,355,325.45	658,563.07	139.76	PUBLISHED MONUMENT
4005	1,347,378.39	655,956.91	135.83	PUBLISHED MONUMENT

PROBE LOCATIONS

ID	NORTHING	EASTING	DEPTH
P1	1,349,559.75	662,698.01	1.64
P2	1,349,471.43	664,530.10	12.37
P3	1,350,580.26	664,853.90	10.09
P4	1,350,976.73	664,154.08	9.57
P5	1,349,988.43	663,829.35	4.09
P6	1,350,396.23	663,240.05	4.26

Richard J. Sawyer Date:
Professional Surveyor and Mapper No. 6131
NOT VALID WITHOUT THE SIGNATURE, DATE AND THE ORIGINAL SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPER

RICHARD J. SAWYER
No. 6131

DATE	BY	REVISION

Project Title:
Dual-Frequency Bathymetric Survey
of Lake Bonnet Located in
Lakeland, Florida

Prepared For:
AECOM
110 East Broward Boulevard, Suite 700
Fort Lauderdale, Florida 33301

Arc Surveying & Mapping, Inc.
Professional Hydrographers • Surveyors • Mappers
5202 San Juan Avenue
Jacksonville, Florida 32210
904.384.8377

LB No. 6487
Drawn By: M. SAWYER
Scale: 1" = 100'
Plot Date: 03/22/24
Checked By:F. SAWYER
Fld Bk / Pg: 24-03/3-7
ARC Project No.:
23-004
SHEET: 1 OF: 8

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Drawn By: M. SAWYER
Scale: 1" = 100'
Plot Date: 03/22/24
Checked By: F. SAWYER
Fld Bk / Pg: 24-03/3-7
ARC Project No.:
23-004
SHEET: 2 OF: 8

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Fort Lauderdale, Florida 33301

Project Title:
Dual-Frequency Bathymetric Survey
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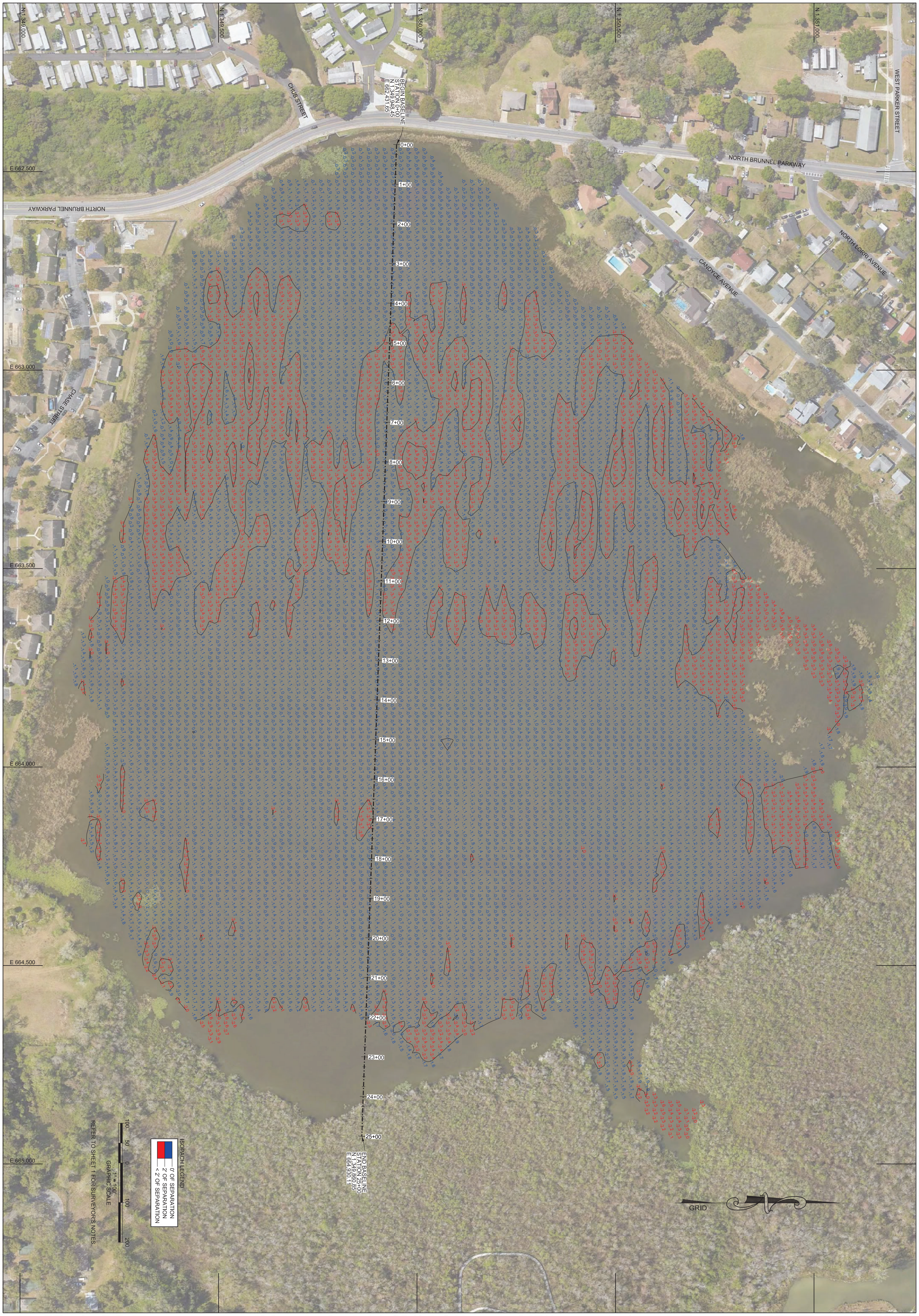
Lakeland, Florida

HIGH-FREQUENCY PLAN VIEW

DATE	BY	REVISION



REFER TO SHEET 1 FOR SURVEYOR'S NOTES.

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ARC Project No.:
23-004
SHEET: 3 OF: 8

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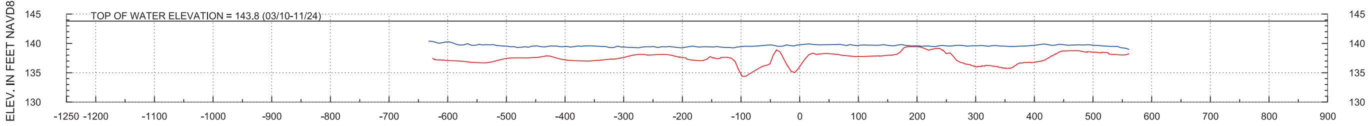
110 East Broward Boulevard, Suite 700
Fort Lauderdale, Florida 33301

Project Title:

Dual-Frequency Bathymetric Survey
of Lake Bonnet Located in
Lakeland, Florida

HIGH/LOW FREQUENCY ISOPACH

DATE	BY	REVISION



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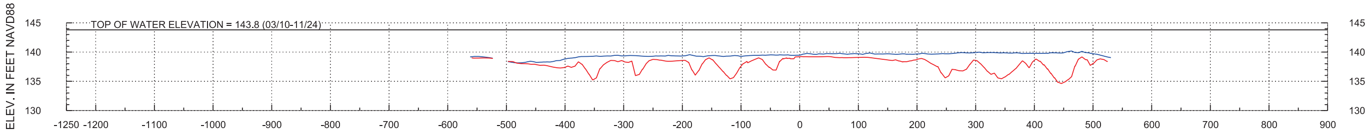

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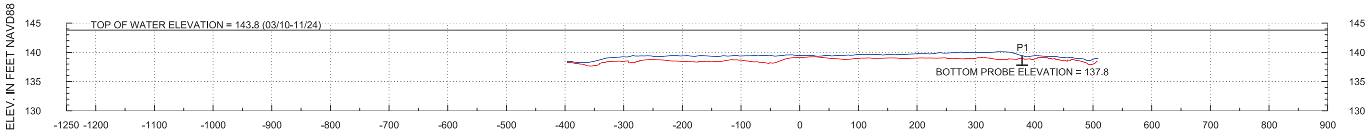

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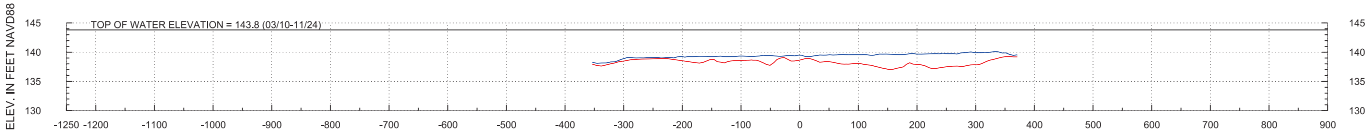

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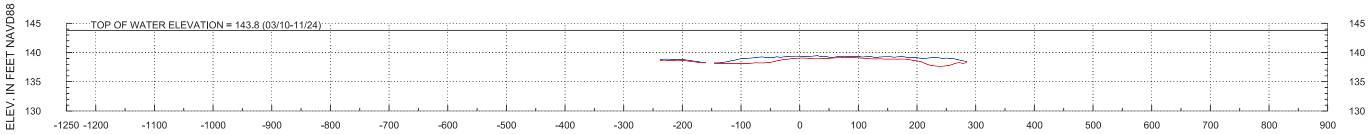

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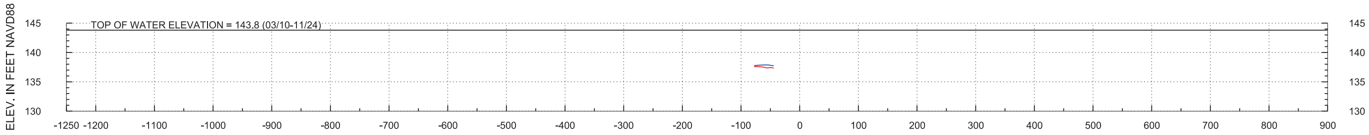

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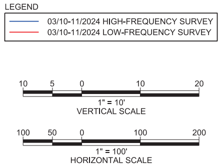

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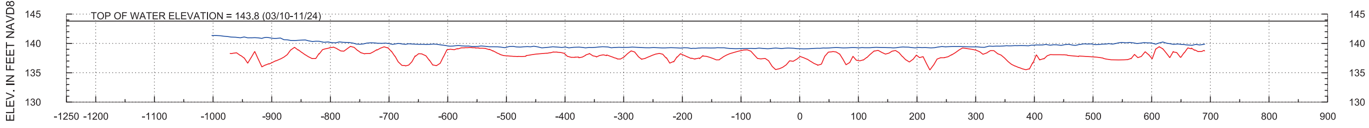
ARC Project No.: 23-004
SHEET: 4 OF: 8



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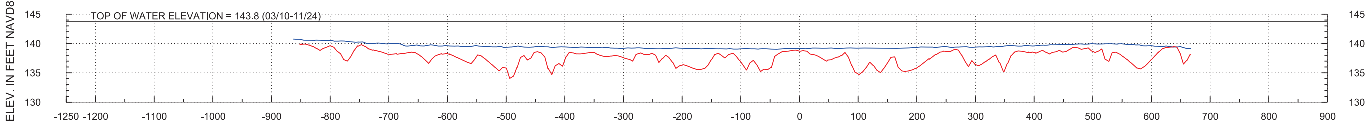

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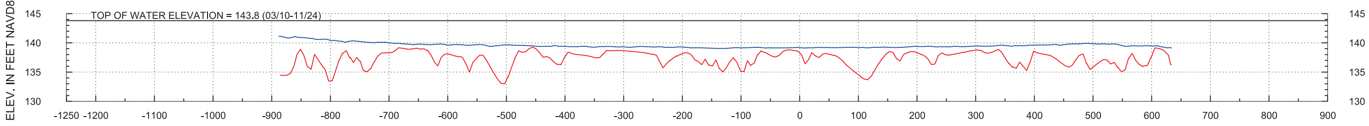

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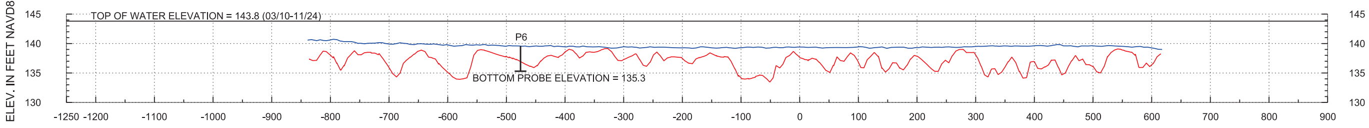

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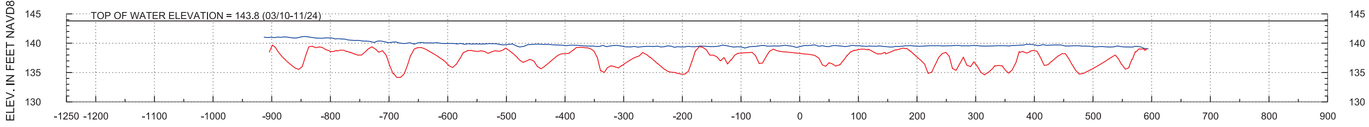

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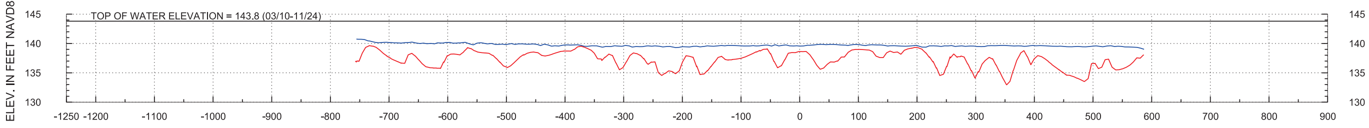

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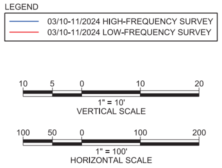

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ARC Project No.:
23-004
SHEET: 5 OF: 8

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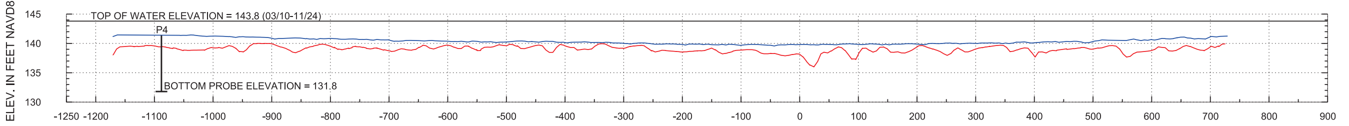

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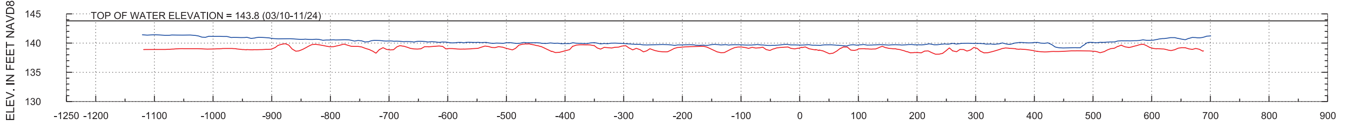

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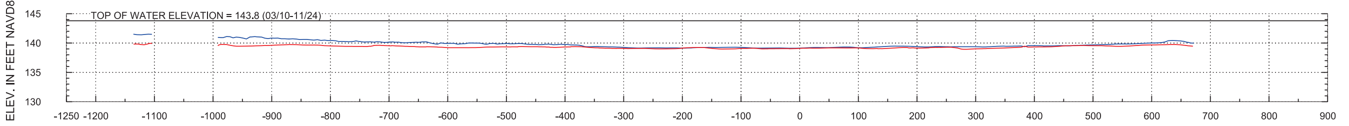

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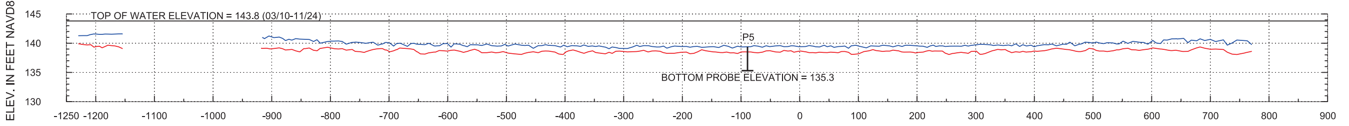

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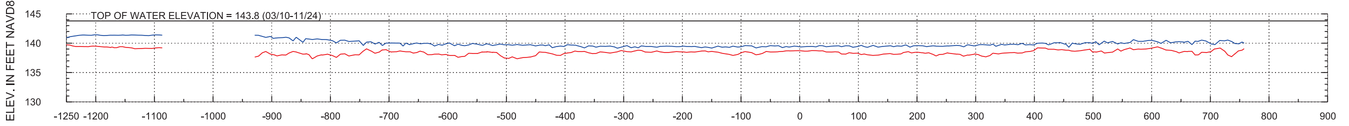

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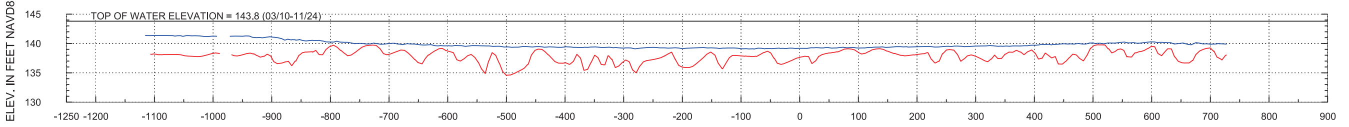

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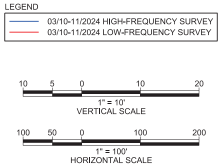

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23-004
SHEET: 6 OF: 8

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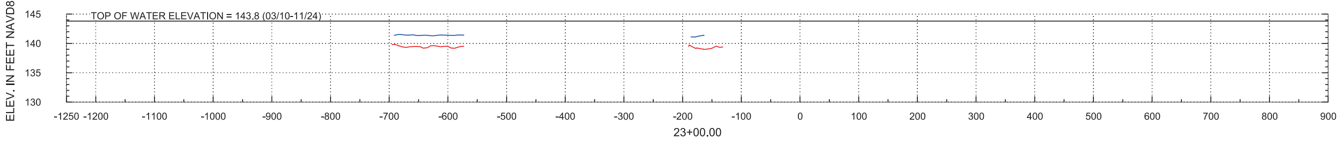

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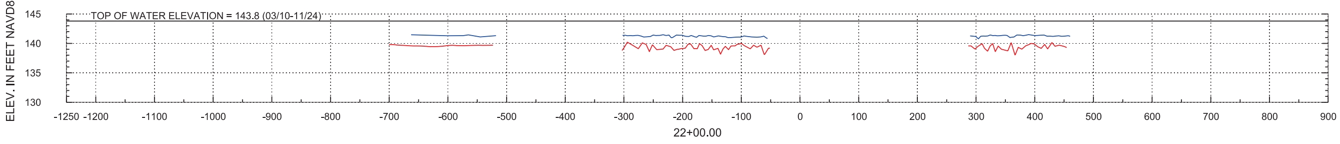

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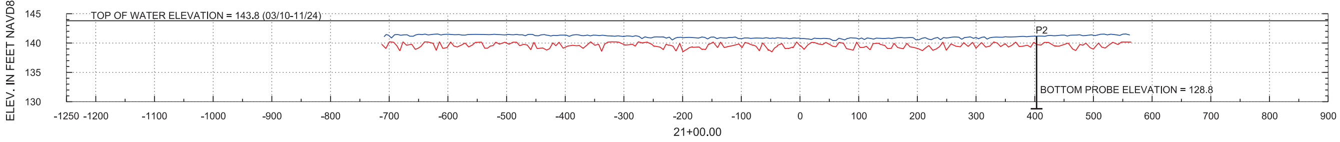

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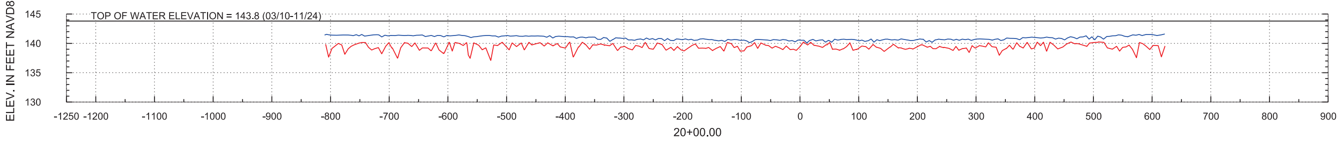

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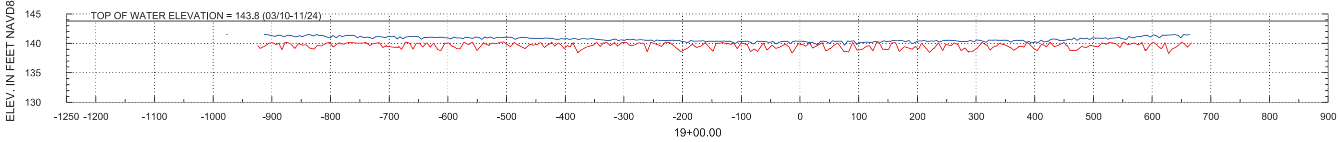

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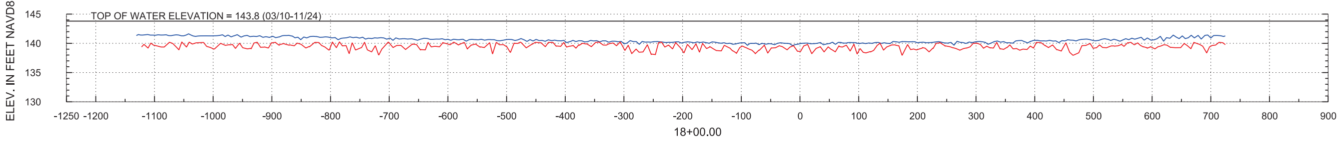

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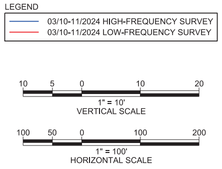

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Prepared For:
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110 East Broward Boulevard, Suite 700
Fort Lauderdale, Florida 33301

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LB No. 6487
Drawn By: M. SAWYER
Scale: 1" = 100'
Plot Date: 03/22/24
Checked By: F. SAWYER
Fld Bk / Pg: 24-03/3-7
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SHEET: 7 OF: 8

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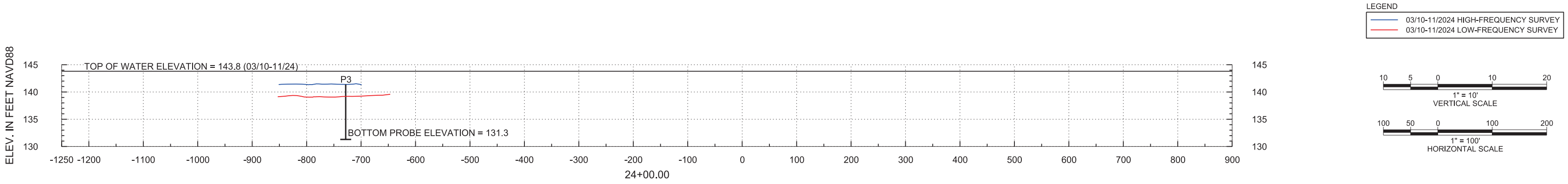

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23-004

SHEET: 8 OF: 8

APPENDIX H

BIOLOGICAL ASSESSMENT REPORT

Attachment H
Biological Assessment Report

Lake Bonnet Dredging and Restoration – Phase 2

City of Lakeland, Polk County, Florida

Project Number: 60721840

Quality information

Prepared by	Checked by	Verified by	Approved by
James Salafia Project Ecologist	Ramon Mendieta Senior Ecologist	Keith Stannard Technical Director	TBD Title

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	06/28/2024	Draft	-	-	-

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

City of Lakeland, Polk County, Florida

Prepared by:

AECOM Technical Services, Inc.
110 East Broward Blvd, Suite 700
Fort Lauderdale, FL 33301
aecom.com

Table of Contents

Tables

Figures

Appendices

Executive Summary

AECOM was contracted by the City of Lakeland to support the City's Lake Bonnet Drainage Basin Flood Hazard and Debris Mitigation Project. AECOM prepared this Biological Assessment Report in support of the project. The core Lake Bonnet study area is located within the City of Lakeland west of Bonnet Springs Boulevard and Bonnet Springs Park and east of N. Wabash Avenue bordered to the north by W. Memorial Boulevard and to the south by George Jenkins Boulevard in Polk County, Florida. The Biological Assessment (BA) study area is larger, encompassing both the core Lake Bonnet study area and additional area immediately west of N. Wabash Avenue extending beyond N. Galloway Road. The BA was extended to capture wetland, surface water and wildlife contributing and contiguous areas for the purposes of the upcoming National Environmental Policy Act (NEPA) study for this project.

The purpose of this BA Report is to identify and delineate all wetlands/surface waters, evaluate the potential for the site to contain suitable habitat to support protected species (i.e., state listed or federally listed species), characterize undeveloped habitats present within the study area, identify potential adverse impacts to natural resources that could result from implementing the project's proposed action, and provide scientific data for future planning in particular to avoid or minimize any potential impacts to natural resources as a result of the project.

AECOM biologists identified and delineated wetlands and surface waters within the study area between April 14, 2024 and April 27, 2024. A total of 18 wetland areas were identified and delineated. The federal data form, Wetland Determination Data Form – Atlantic and Gulf Coastal Plain Region, was completed in the field to document each wetland feature. Additionally, a total of four channelized watercourses (canals), 12 lakes, 33 stormwater retention/detentions features, and four wet ditches were identified and delineated within the study area for a total of 71 wetland/surface water features.

The study area was also evaluated for potential occurrences of federal and state listed wildlife and plant species between March 18-21, 2024 in accordance with the Endangered Species Act (ESA) of 1973; as amended; the Fish and Wildlife Conservation Act; the Migratory Bird Treaty Act (MBTA); the Bald Eagle and Golden Eagle Protection Act (BGEPA); and the State of Florida Wildlife Rule 68A-27.003 Florida Administrative Code (F.A.C.). Field review, scientific research and available online data including Florida Fish and Wildlife Conservation Commission (FWC) databases, US Fish & Wildlife Service (USFWS) databases and Information for Planning and Consultation (IPaC), and Florida Natural Areas Inventory (FNAI) databases, were used to identify the potential occurrences of protected species and associated critical habitat within the study area. Based on this evaluation, 22 federally protected species were identified with the potential to inhabit the area. This includes three avian, one reptile, one amphibian, 16 plant, and one insect species. The study area is also located within the USFWS Consultation area for six species including four birds and two reptiles. Additional State listed species with the potential to occur within the study area include one mammal, six avians, one reptile, one amphibian, and ten plants. Also, twelve additional bird species protected solely under the Migratory Bird Treaty Act have the potential to occur within the study area.

Nine federal and/or state protected species were observed within the study area during the wildlife and plant field efforts. Additionally, two protected bird species including the wood stork (*Mycteria americana*) and roseate spoonbill (*Platalea ajaja*) were observed nesting within the study area.

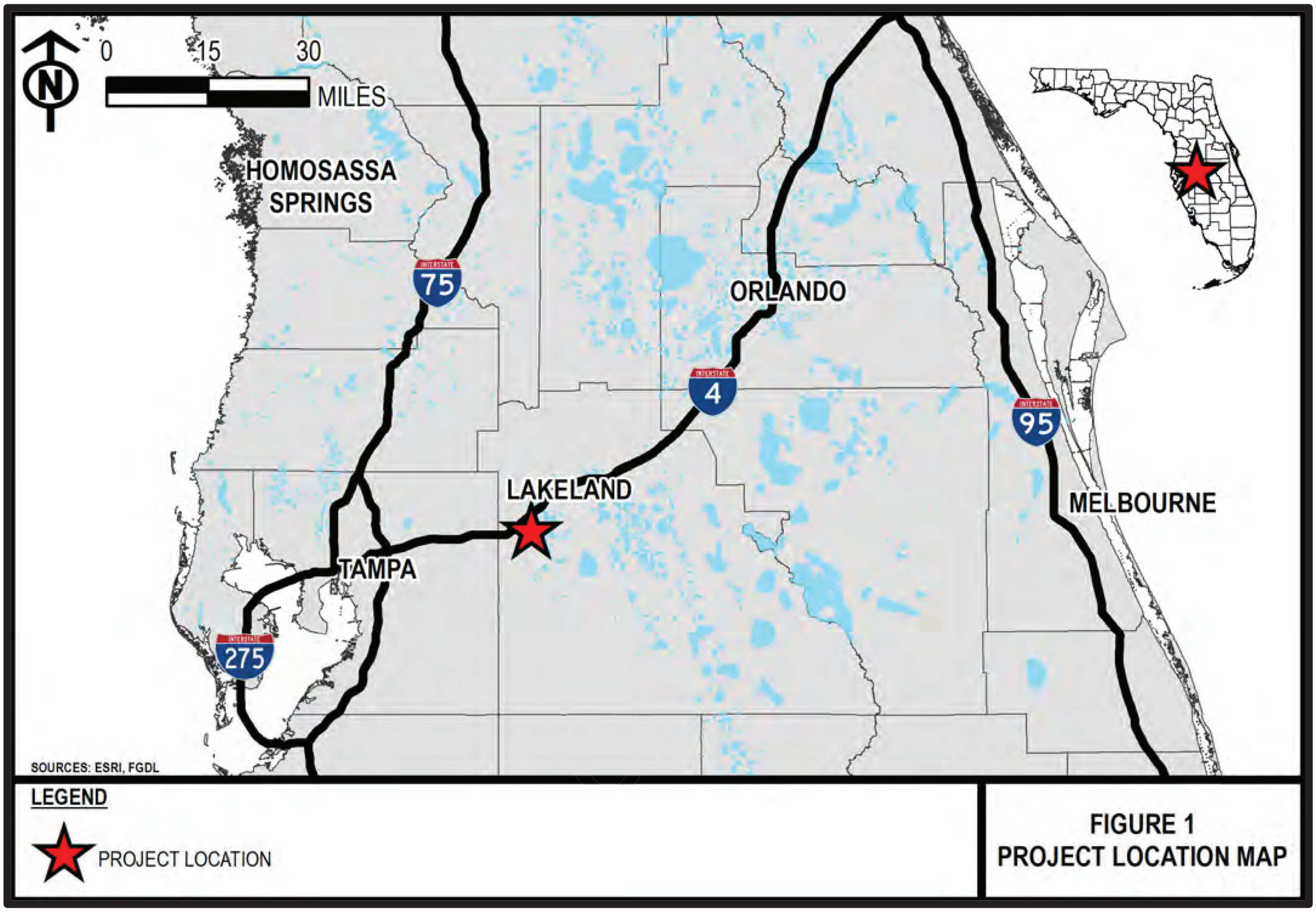
Any potential impacts to protected natural resources including wetlands, surface waters, and protected plants or wildlife will require authorization through the applicable regulatory agencies. Once the preferred alternative or action is selected, a complete list of permitting requirements will be established.

Maps/Figures were developed to provide a visual representation of the study area and resources observed. These figures have been incorporated into this report.

1. Introduction

The core Lake Bonnet study area is located within the City of Lakeland, west of Bonnet Springs Boulevard and Bonnet Springs Park and east of N. Wabash Avenue bordered to the north by W. Memorial Boulevard and to the south by George Jenkins Boulevard in Polk County, Florida

Figure 1: Project Location Map



The City of Lakeland intends to assist disproportionately disadvantaged communities which have been impacted by flooding in the vicinity of Lake Bonnet. By mitigating flooding risk to these communities, the project will have a lasting and positive impact on the city, neighboring residential communities, and businesses. This project is funded by the Community Development Block Grant Mitigation (CDBG-MIT) program to mitigate flooding in one of our State's Most Impacted and Distressed (MID) areas. The preferred action, not yet selected, may include improvements to the stormwater conveyance system, coupled with enhancements to the storage capacity and littoral wetlands in Lake Bonnet.

The NEPA process is triggered by a Federal "Action". The NEPA requires federal agencies to consider the environmental impact of their actions before funding, authorizing, or implementing them. NEPA also aims to ensure that the public has access to information about environmental impacts before decisions are made. In this context, the "Action" would be funding of the project through the CDBG-MIT program administered by the Department of Housing and Urban Development (HUD). To comply with NEPA reporting requirements per *42 U.S.C. § 4321*, AECOM developed the study area to encompass the areas within the core Lake Bonnet study area as well as wetland, surface water and wildlife contributing and contiguous areas across multiple properties resulting in larger study area of approximately 1,355.22 acres. The overall study area for this BA includes the study area as previously defined (area around Lake Bonnet to N. Wabash Avenue) and additional undeveloped areas immediately west of N. Wabash Avenue extending beyond N. Galloway Road. This larger study area captures wetland, surface water, and wildlife contributing and contiguous areas (Figure 2 – Project Study Area).

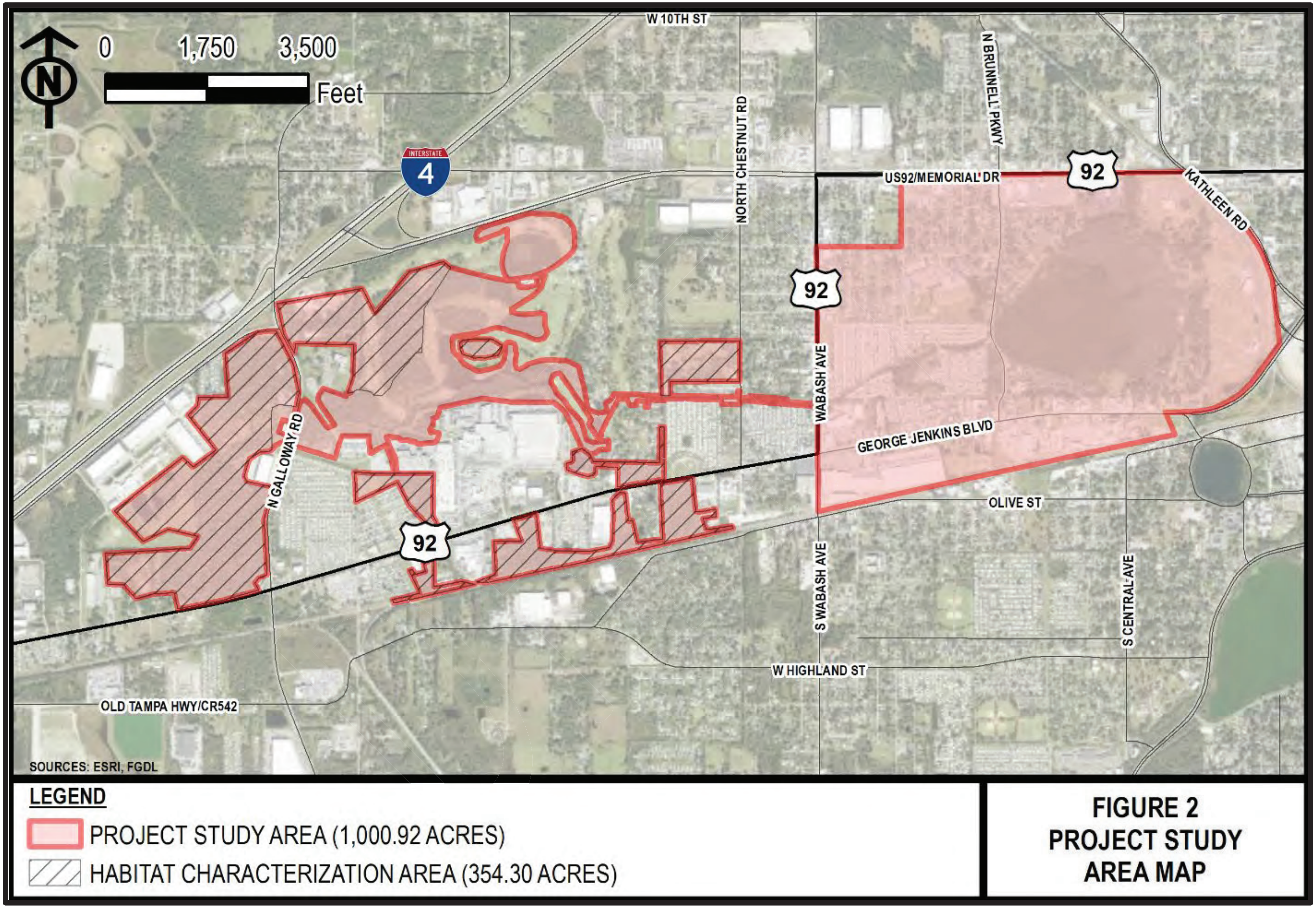


Figure 2: Project Study Area Map

2. Study Area Review

2.1 Study Area Setting

Much of the study area is developed; however, undeveloped forested areas, wetlands, and water bodies are interspersed throughout. The surrounding areas consist of both high and low density residential and commercial development. To the north are residential communities and commercial businesses along US-92 (West Memorial Blvd). To the east is the Lakeland City Center, City Hall, Lake Wire and numerous residential apartments, commercial and government facilities, and other structures. To the south are residential communities and commercial businesses along US-92 (New Tampa Highway). To the west are industrial complexes, distribution centers, and the major intersection of Interstate-4 and Polk Parkway (SR-570).

There are many property owners within the study area including eight major property owners containing 30 acres or more. From east to west, the major property owners include Bonnet Springs Park, City of Lakeland, Polk County, residential communities adjacent to the canal, Publix Corporate Headquarters, and Lone Palm Golf Club. Table 1 below provides additional details of the major property owners within the study area.

Table 1: Major Property Owners within the Study Area*

Property Owner	Parcel ID	Physical Address	Acreage
Roundhouse Holdings LLC	232813000000033020	139 Bonnet Springs Blvd Lakeland 33815	163.73
AAN TV Realty Inc.	232814000000012010	833 CANDYCE AVE LAKELAND 33815	15.01
Polk County	232814000000012020	Lake Bonnet Lakeland 33803	65.51
City of Lakeland	232814000000014010	501 Brunnell Pkwy Lakeland 33803	12.35
Walco Enterprises, Inc	232814000000021010	1203 W CHASE LAKELAND 33815-1349	3.40
BONNET SHORES LLLP	232814000000021020	303 N BRUNNELL PKWY LAKELAND 33815	12.58
Pete Devine	232814000000021030	CHASE ST W LAKELAND 33815	1.25
BCORE May Manor LLC	232814000000023010	340 Brunnell Pkwy Lakeland 33801	44.41
Sterling MHC Partners LLC	232814000000043040	252 Lyndol St Lakeland 33801	31.86
Lone Palm Golf Club LLC	232815085500001300	800 Lone Palm Dr Lakeland 33815	338.17
Publix Super Markets INC	232815085500002500	New Tampa Hwy Lakeland 33815	37.1307
Publix Super Markets INC	232816000000022010	3045 New Tampa Hwy Lakeland 33802	93.41

*Polk County Property Appraiser (https://map.polkpa.org/)

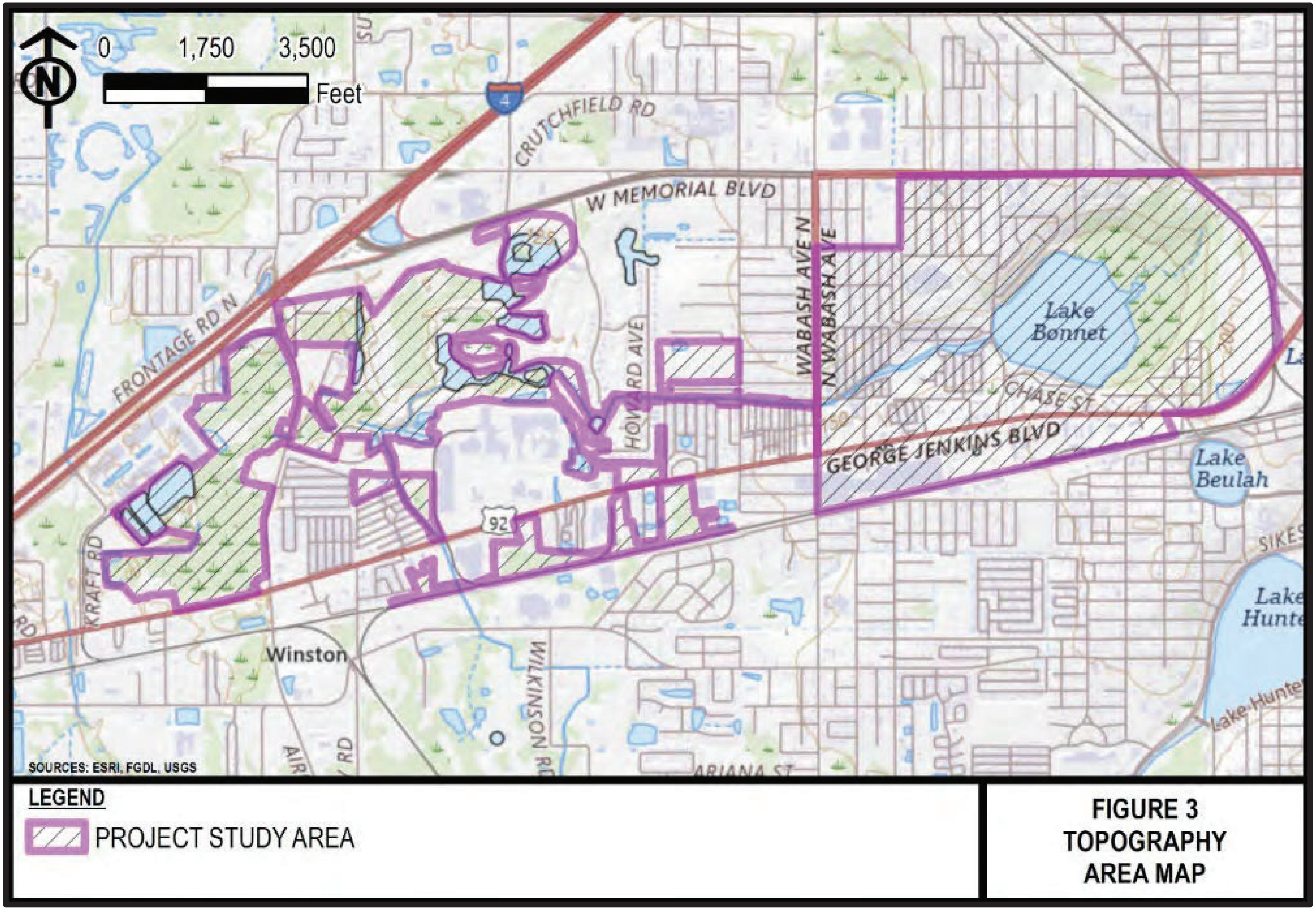
The property owners of the shoreline and lake bottom of Lake Bonnet including, Polk County, City of Lakeland, Mr. Pete Devine, AAN TV Realty, Inc., Walco Enterprises, Inc, and Roundhouse Holdings LLC., are key stakeholders that will require close coordination for the duration of the project.

2.2 Topography / LiDAR

Prior to the biological field investigations, an aerial survey was conducted with the use of an unmanned aircraft system (UAS) commonly referred to as drone. The primary objective of this effort was to collect accurate measurements of the bare-earth surface to serve as geospatial inputs for documentation, hydraulic modelling, and future planning efforts. Imagery was also collected to deliver a high resolution orthomosaic to use background/contextual support and to document site conditions during the date of the flights.

The drone survey consisted of collecting Light Detection and Ranging (LiDAR) and photogrammetric data. The LiDAR point cloud was used to produce a digital elevation model (DEM) to assist with designing engineered solutions for flood mitigation. The drone imagery was stitched together by a team of photogrammetrists to produce a high resolution orthorectified mosaic map (aerial imagery). The detailed aerial imagery was utilized during the desktop evaluation of the study area to assist with preliminary identification of the extent of wetlands and surface water/drainage features. Based on a review of the LiDAR data and USGS topographic data (**Figure 3 – Topography**), the study area appears to have an approximate slope of 0.4% from approximately 200 feet above sea level (ASL) in the east to approximately 125 feet ASL in the west spanning approximately 3.5 miles in length.

Figure 3: Topography Area Map



2.3 Soils

According to the US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) website, the entire study area contains 20 distinct soil types. The soil types with the largest percent areal coverage are Pomona fine sand (10%), Myakka-Immokolee-Urban land complex (16%), and Arents-Urban land complex, 0 to 5 percent slopes (14%) with other soil types consisting of less than ten percent each. A summary of each soil type mapped by the NRCS within the study area is provided in **Table 2** below.

Soils within the study area (**Figure 4 – Soils**) can be generally described as poorly drained to very poorly drained. The Florida Association of Environmental Soil Scientists (FAESS) considers the main component of five of the 20 soil types to be hydric with an additional five soil types with hydric inclusions present. This information can be found in the *Hydric Soils of Florida Handbook, Third Edition*, March 2000. Please see **Appendix A – Web Soil Survey Report** for more details. This report, which was developed by the National Cooperative Soil Survey, a joint effort of the NRCS and other Federal agencies, State agencies such as the Agricultural Experiment Stations, and local participants.

Table 2: Characteristics of Soils Mapped within the Study Area

Soil Name	Soil Symbol	Drainage Class	Hydric/ Inclusions	% of Study Area
Pomona fine sand	7	Poorly drained	Inclusions	10.0%
Samsula muck, frequently ponded, 0 to 1 percent slopes	13	Poorly drained	Hydric	1.9%
Sparr sand, 0 to 5 percent slopes	14	Poorly drained	Not hydric	4.8%
Tavares fine sand, 0 to 5 percent slopes	15	Well drained	Not hydric	0.7%
Urban land, 0 to 2 percent slopes	16	Poorly drained	Not hydric	5.0%
Smyrna and Myakka fine sands	17	Poorly drained	Inclusions	3.9%
Immokalee sand	21	Poorly drained	Inclusions	8.9%
Placid and Myakka fine sands, depressional	25	Poorly drained	Hydric	0.1%
Kendrick fine sand, 0 to 5 percent slopes	27	Well drained	Not hydric	0.9%
Adamsville fine sand, 0 to 2 percent slopes	31	Poorly drained	Not hydric	1.1%
Kaliga muck, frequently ponded, 0 to 1 percent slopes	32	Poorly drained	Hydric	3.6%
Hontoon muck, frequently ponded, 0 to 1 percent slopes	35	Poorly drained	Hydric	1.4%
Felda fine sand	42	Poorly drained	Hydric	3.3%
Adamsville-Urban land complex	49	Poorly drained	Not hydric	2.2%
Pomona-Urban land complex	51	Poorly drained	Inclusions	6.8%
Myakka-Immokolee-Urban land complex	53	Poorly drained	Inclusions	16.1%
Sparr-Urban land complex, 0 to 5 percent slopes	55	Poorly drained	Not hydric	3.3%
Arents-Urban land complex, 0 to 5 percent slopes	59	Poorly drained	Not hydric	14.0%
Arents, sandy	60	Well drained	Not hydric	0.1%
Arents, organic substratum-Urban land complex	61	Poorly drained	Not hydric	1.9%
Water	99	N/A	N/A	7.0%

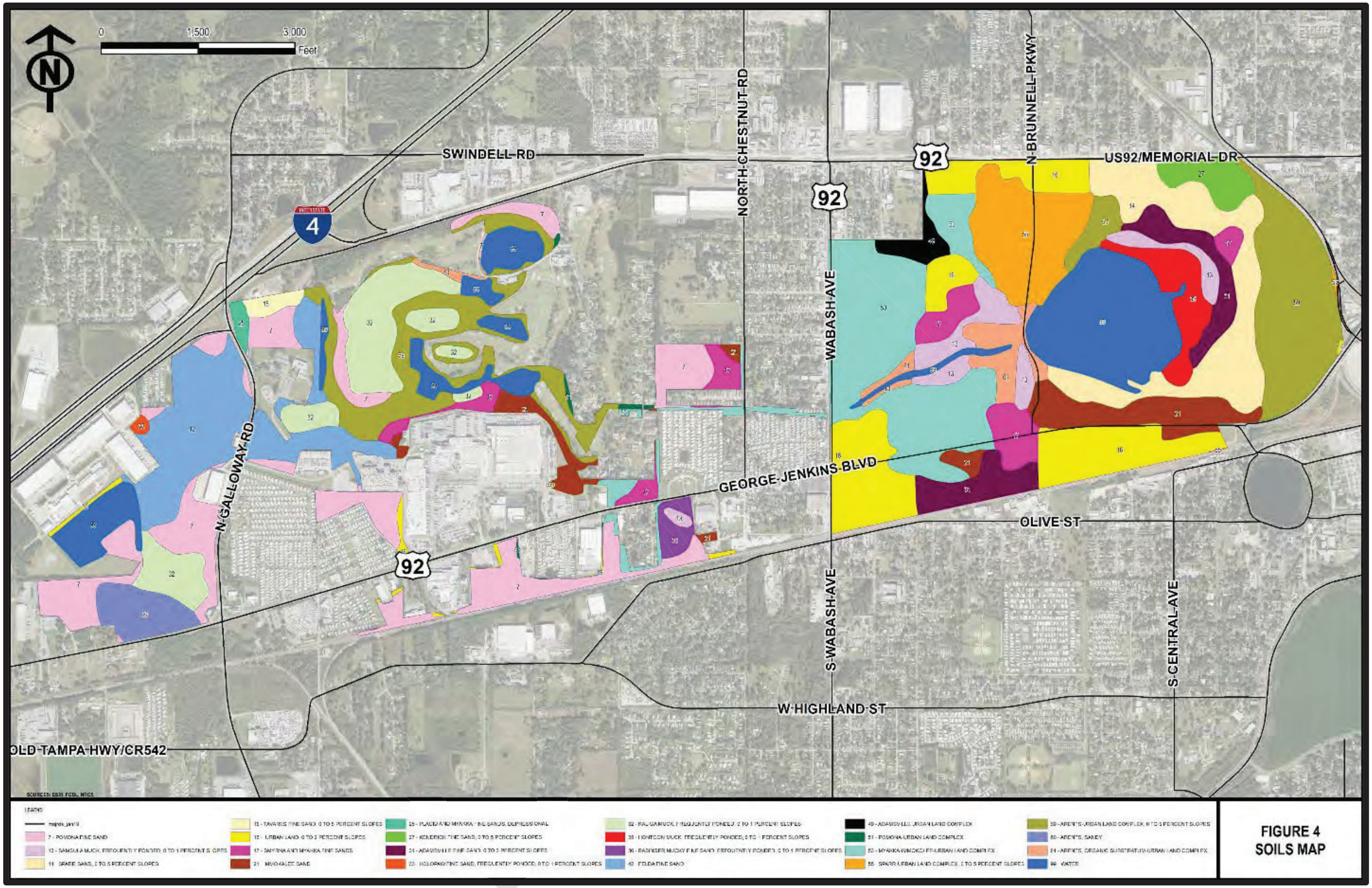


Figure 4: Soils Map

2.4 Land Use Classifications

Seventeen land use community types were identified within the study area consisting of residential, commercial, industrial, institutional, recreational, upland, farmland, water, and wetland. These distinct land use types were classified using *Florida Land Use, Cover, and Forms Classification System* (FLUCFCS) (FDOT, 1999) (**Table 3**). **Figure 5** depicts the delineated boundaries of each land use type/vegetative community within the study area.

Table 3: Land Use Classifications within the Study Area

FLUCFCS Classification / Description	Land Use Type
110 - Residential, Low Density (Less Than Two Dwelling Units Per Acre)	Residential
120 - Residential, Medium Density (Two-Five Dwelling Units Per Acre)	Residential
130 - Residential, High Density (Six Or More Dwelling Units Per Acre)	Residential
140 - Commercial and Services	Commercial
150 – Industrial	Industrial
170 - Institutional	Institutional
182 - Golf Courses	Recreational
190 - Open Land	Upland
210 - Cropland and Pastureland	Farmland
434 - Hardwood - Conifer Mixed	Upland
510 - Streams and Waterways	Water
520 - Lakes	Water
530 - Reservoirs	Water
615 - Stream and Lake Swamps (Bottomland)	Wetland
641 - Freshwater Marshes	Wetland
643 – Wet Prairies	Wetland
644 - Emergent Aquatic Vegetation	Wetland
810 - Transportation	Industrial

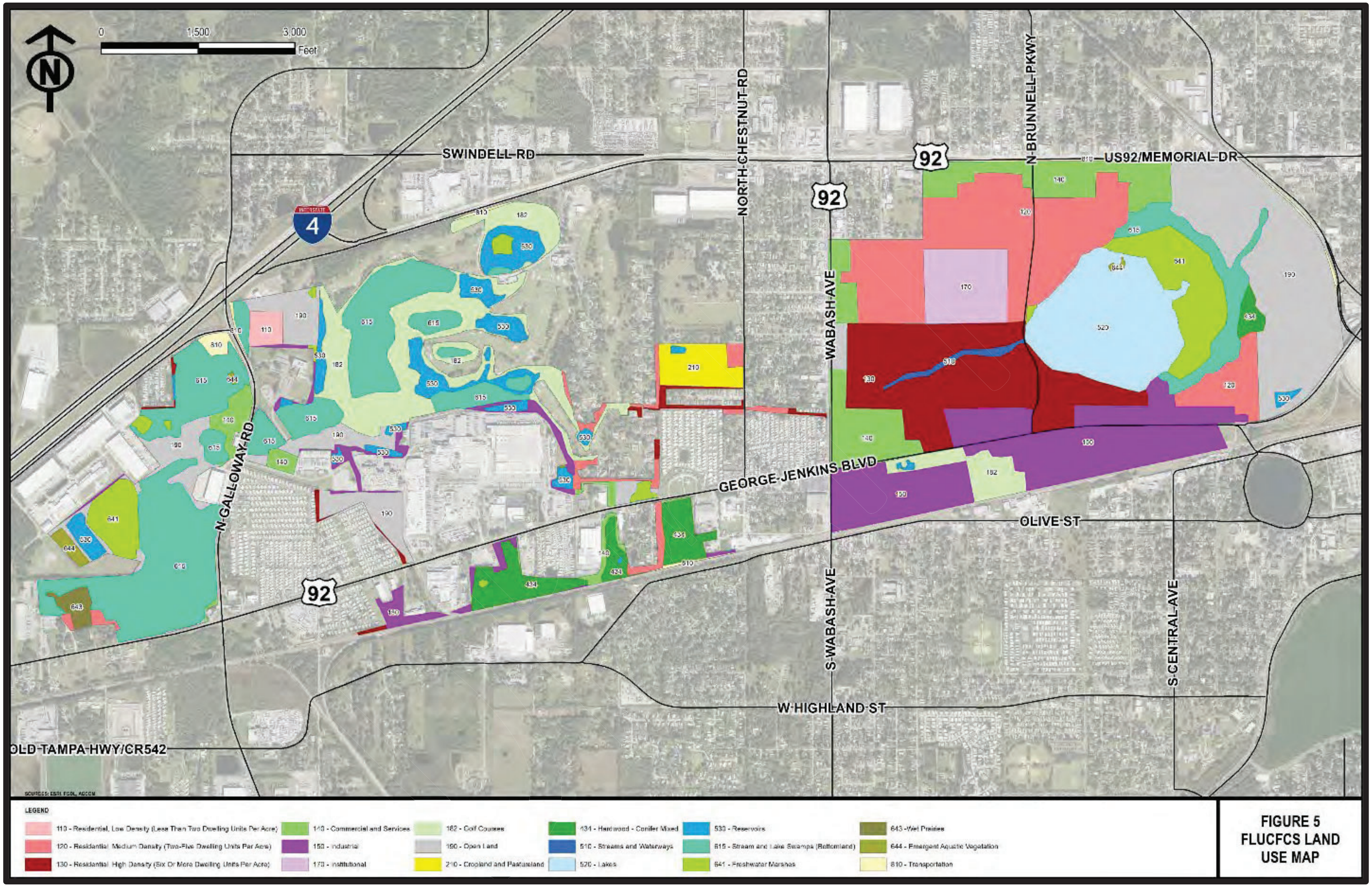


Figure 5: FLUCFCS Land Use Map

3 Methodology

3.1 Desktop Review

Background research was conducted of relevant publicly available sources prior to field surveys to identify potential natural resources within the study area. These sources included, but were not limited to, the following:

- USGS topographic data
- USDA-NRCS soil survey data
- USFWS National Wetland Inventory (NWI) Wetland Mapper (2024)
- USFWS Classification of Wetlands and Deepwater Habitats of the United States (1979)
- ESRI GIS Data and Aerial Photography
- USFWS Information for Planning and Consultation (IPaC) (2024)
- USFWS Environmental Conservation Online System, Polk County (2024)
- USFWS Critical Habitat Portal, Study Area (2024)
- FWC Online Imperiled Species List (2024)
- FWC Eagle Nest Locator
- Audubon Center for Birds of Prey, Study Area (2024)
- FNAI Tracking List, Polk County (2024)
- FNAI Field Guide to the Rare Plants and Animals of Florida Online (2024)
- FNAI Standard Data Report

3.2 Aerial LIDAR and Photogrammetry

AECOM drone pilots, certified by the Federal Aviation Administration (FAA) conducted an aerial survey of the study area from February 18-23, 2024. Flying a USA-made Wattson Innovations Prism Sky octocopter drone holding a TrueView dual LIDAR and imagery sensor. The team produced a digital elevation model from the LIDAR point cloud and an orthorectified aerial mosaic from the photos systematically collected during the survey. The topographic survey data along with the ortho-mosaic were utilized for initial desktop delineation of natural resources (wetlands, surface waters and undeveloped upland features) prior to conducting the field surveys.

3.3 Wetland Delineation

An in-depth desktop evaluation was completed to identify the presence of wetlands and surface water features which may occur within the study area. Utilizing the background research including the high resolution orthorectified aerial mosaic, wetlands and surface water features were preliminarily identified and mapped for ground-truthing in the field.

The field survey was conducted to visually inspect, delineate, characterize, and photograph all water features within the study area including wetlands, canals, and other stormwater drainage features between April 14, 2024 and April 27, 2024. AECOM biologists utilized aerial maps and navigated the different habitats within the study area to confirm the presence of wetlands/surface waters. Once a wetland or surface water was identified, the limits were delineated by taking digital points using ESRI Field Maps application with a high-accuracy Trimble R2 GPS antenna. Wetlands and surface water boundaries were delineated using the current federal and state methodologies identified within the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region* (USACE 2010) and Chapter 62-340.300(2) of the Florida Administrative Code (F.A.C.). The water features were classified in accordance with the *Classification of Wetlands and Deepwater Habitats of the United States* (USFWS 1992) and the National Wetland Inventory (NWI) classification system. This survey refined the preliminary inventory created during the desktop analysis.

Soils were evaluated by digging a soil sample pit within each wetland and a soil sample pit within the immediately adjacent upland area. Soil characteristics, hydrologic indicators, and dominate vegetative species were recorded on the USACE Wetland Determination Data Form (**Appendix B**). Representative photographs of the wetlands, soils pits, and other distinctive features were collected as visual documentation of site conditions as they existed during the field survey (**Appendix C – Photographic Log**). Attention was given to identifying plant species composition for each community. Exotic plant infestations and other disturbances (such as soil subsidence, clearing, canals, power lines, etc.) were noted. Wildlife observations and signs of wildlife usage within each wetland/surface water habitat within the study area were also documented. Results from the field survey are detailed in **Section 6.0** of this report.

3.4 Wildlife Survey

The study area was evaluated for potential occurrences of federal and state listed plant and wildlife species in accordance with the ESA; the Fish and Wildlife Conservation Act; the MBTA; and Chapters 5B-40 and 68A-27, F.A.C. It is important to note that all federally listed species are also considered state listed species. The study area was also evaluated for the occurrence of federally designated Critical Habitat as defined by Congress in 50 C.F.R. Part 17. Based on this evaluation, it was determined that federally designated Critical Habitat was not present within the study area.

Prior to the field survey, AECOM biologists conducted a desktop evaluation to identify the potential occurrence of any federal or state listed protected species which may have the potential to occur within the study area. This background research included the review of all available data, including agency databases, the FNAI Report (**Appendix D**) and IPAC report (**Appendix E**) to identify the rare, threatened, and endangered wildlife and plant species potentially occurring within the study area and to focus field survey efforts on habitats that could harbor these species. Species-specific surveys were not conducted. Please reference **Section 5.0** of this report for additional information.

Following the desktop evaluation, AECOM biologists conducted a biological field survey to further confirm presence or absence of protected wildlife and plant species within the study area. The survey was conducted between March 18-21, 2024, employing two types of wildlife survey methodology: cursory pedestrian transects and stationary observation points. A total of 15 stationary observation stations were established to maximize the amount of wildlife to be observed during the field assessment. Observation station locations were selected to be evenly distributed throughout differing habitat types within the study area. Each day, the team visited five of the 15 observation stations for a period of approximately 15 minutes at each location in both the morning and the evening. Observations were conducted at sunrise and sunset as wildlife are typically most active during those times. Morning observations took place from 30 minutes prior to the official sunrise through 9:00AM. Evening observations took place from 6:00PM through 30 min after official sunset. The survey included both direct observations and indirect evidence such as tracks, burrows, tree markings, and birdcalls that indicated the presence of species observed. Biologists utilized the Merlin Bird ID application from Cornell Labs to assist with identifying bird vocalizations. During the mid-day hours, pedestrian transects were conducted through each of the vegetative community types to inspect for wildlife and to identify suitable habitat for any protected plant species within the study area. Plant species were inventoried to species level when possible and categorized by stratum per the USACE Wetland Determination Data Form: tree, sapling, shrub, herb, and woody vine. Vegetative communities were qualitatively characterized in terms of dominant plant species, invasive species, and presence of human disturbance. Results from the field survey are detailed in **Section 6.0** of this report.

Additional areas not documented during the wetlands or wildlife surveys but were within the study area were also assessed for NEPA compliance. These habitats comprise approximately 354.30 acres and are depicted in **Figure 6 – Habitat Characterization**. These habitats were characterized based on vegetative species, ecological resources, and suitability for protected wildlife and plants. Cursory pedestrian transects were conducted throughout each of these areas to document community type and their potential to provide suitable habitat for protected species. The pedestrian transects were spaced to provide 100 percent visual coverage of all vegetated portions of each area. Biologists recorded plant species encountered, documented presence and extent of vegetative communities, and identified potential habitat for protected plants and wildlife.

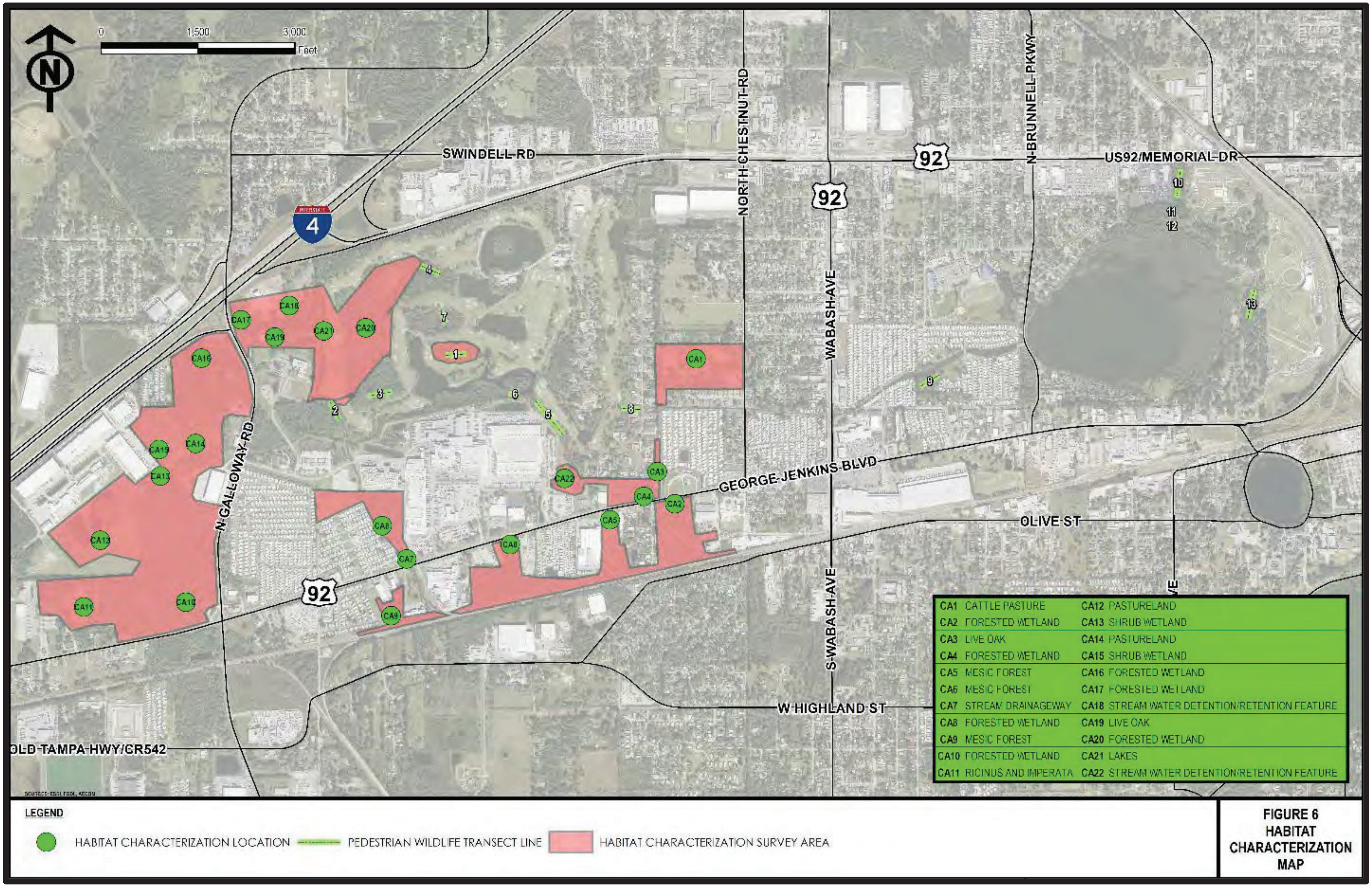


Figure 6: Habitat Characterization Map

4. Protected Species

Protected species within the study area are summarized into **Table 4 - Federally Listed Species**, **Table 5 - USFWS Consultation Area Species**, and **Table 6 - State Listed Species**. These lists were developed to identify the rare, threatened, and endangered wildlife and plant species with the potential to occur within the study area, and to focus field survey efforts on those habitats that could harbor these species.

4.1 Federally Listed Species

AECOM biologists conducted a desktop evaluation to assess the possible presence of federal and state-listed species within the study area. The desktop evaluation identified 27 species with the potential to inhabit the area. This included three bird, one reptile, one amphibian, 16 plant, and one invertebrate species (**Table 4**). Each federally listed species identified are discussed in terms of their habitat and the likelihood of their presence or absence within the study area based on the desktop analysis.

Each species listed in **Table 4** was assigned a potential for occurrence within the study area based on data reviews, field observations, presence and quality of suitable habitat, and the species' known ranges. Each species was assigned a likelihood of occurrence of either none, low, moderate, or high based on the following:

None – The project is outside of the species' known range, or the project is within the species' range; however, no suitable habitat for or previous documentation of this species occurs within or adjacent to the project study area, and it was not observed during the field reviews.

Low – The project is within the species' range, and minimal or marginal quality habitat exists within or adjacent to the project study area; however, there are no documented occurrences of the species in the vicinity of the project, and it was not observed during the field reviews.

Moderate – The project is within the species' range and suitable habitat exists within or adjacent to the project study area; however, there are no documented occurrences of the species, and it was not observed during the field reviews.

High – The project is within the species' range, suitable habitat exists within or adjacent to the project buffer, there is at least one documented occurrence of the species within the project study area, and/or the species was observed during the field reviews.

A summary of protected species, along with their corresponding likelihood of occurrence, is provided in Table 4.

Table 4: Federally Listed Species

Common Name	Scientific Name	Habitat Description	Likelihood of Occurrence	Federal Status	State Status
		Birds			
Crested Caracara	*Caracara cheriway*	Audubon's crested caracara inhabits areas with open land, such as dry prairie and pasture lands with cabbage palm (Sabal palmetto), cabbage palm/live oak (Quercus spp.) hammocks, and shallow ponds and sloughs. This species prefers to nest in cabbage palm trees and live oaks.	Low	T	FT
Eastern Black Rail	*Laterallus jamaicensis* ssp. *jamaicensis*	Nests in or along edge of marsh, in area with saturated or shallowly flooded soils and dense vegetation, usually in site hidden in marsh grass; on damp ground, on mat of previous year's dead grasses, or over very shallow water.	Low	T	FT
Everglades Snail Kite	*Rostrhamus sociabilis plumbeus*	This bird prefers shallow freshwater marshes and grassy shorelines of lakes. This species feeds almost exclusively on apple snails, which are caught at or near the water's surface.	Low	E	FE
Florida Grasshopper Sparrow	*Ammodramus savannarum floridanus*	Suitable habitat for the Florida grasshopper sparrow consists of treeless, relatively poorly-drained grasslands that have a history of frequent fires. These habitats are generally dominated by low-growing prairie grasses with scattered saw palmetto (Serenoa repens) and dwarf oaks (Quercus minima).	Low	E	FE
Florida Scrub Jay	*Aphel+ocoma coerulescens*	Typically persists in areas with well-drained sandy soils and fire-dominated, low-growing, oak scrub habitat. This species sometimes lives in areas with overgrown scrub or sparser oaks, but at much lower populations and with reduced chances of survival.	Low	T	FT
Red-cockaded Woodpecker	*Picoides borealis*	Mature pine forests with little to no midstory, especially longleaf pines (*Pinus palustris*)	Low	E, PT	FE
Wood Stork	*Mycteria americana*	Inundated forested wetlands (including cypress strands and domes), mixed hardwood swamps, mangroves, and sloughs. Artificial habitats such as impoundments and dredged areas with native or exotic vegetation.	High	T	FT